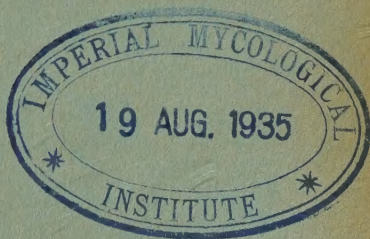


20/0
THE

Tea Research Institute OF Ceylon.

BULLETIN No. 12

Annual Report for the Year
1934.



Published by

THE TEA RESEARCH INSTITUTE OF CEYLON,
VICTORIA COMMEMORATION BUILDINGS, KANDY.

The Tea Research Institute of Ceylon.

BOARD OF CONTROL.

(A) Representing the Planters' Association of Ceylon:—

- (1) Mr. R. G. Coombe
- (2) Mr. Jas. Forbes, (Jnr.) (Chairman),
- (3) Mr. J. D. Hoare.

(B) Representing the Ceylon Estates Proprietary Association:—

- (4) Mr. D. T. Richards.
- (5) Major J. W. Oldfield, M.C., C.M.G., O.B.E.
- (6) Mr. I. L. Cameron.

(C) Representing the Low-Country Products' Association:—

- (7) Colonel T. G. W. Jayewardene, V. D.

(D) Representing the Small-Holders:—

- (8) Mr. D. H. Kotalawala, M.S.C.

(E) Ex-Officio Members:—

- (9) The Hon. the Financial Secretary.
 - (10) The Director of Agriculture.
 - (11) The Chairman, Planters' Association of Ceylon.
 - (12) Chairman, Ceylon Estates Proprietary Association.
-

Secretary, Mr. A. W. L. Turner, Victoria Commemoration Buildings, Kandy.

NINTH ANNUAL REPORT

OF THE

BOARD OF THE TEA RESEARCH

INSTITUTE OF CEYLON

FOR 1934.

Foundation :—The Tea Research Institute of Ceylon was established and the Board of Management incorporated by Ordinance No. 12 of 1925, dated the 27th October, 1925.

Past Chairmen of the Institute.

Name	Date of Appointment	Date of Resignation.
Major J. W. Oldfield, C.M.G., O.B.E., M.C.	7th January, 1926	24th November, 1926
Mr. John Horsfall	24th November, 1926	14th April, 1927
Mr. R. G. Coombe	14th April, 1927	9th April, 1929
Major J. W. Oldfield, C.M.G., O.B.E., M.C.	9th April, 1929	30th September, 1929
Mr. C. Huntley Wilkinson	30th September, 1929	28th November, 1929
Mr. R. G. Coombe	29th November, 1929	7th April, 1932
Mr. G. K. Stewart	7th April, 1932	26th November, 1932
Mr. R. G. Coombe	26th November, 1932	13th January, 1934
Mr. Jas. Forbes (Jnr.)	13th January, 1934	

Board of Management :—On the 1st January, 1934, the Board of Management comprised the following Members :—

Ex-Officio Members.

The Hon'ble the Financial Secretary, (Sir Wilfrid Woods, C.M.G.).
The Director of Agriculture, (Dr. W. Youngman, D.Sc., Ph.D.).
The Chairman, Planters' Association of Ceylon, (Mr. B. M. Selwyn).
The Chairman, Ceylon Estates Proprietary Association of Ceylon,
(Mr. C. E. Hawes).

Representatives of the Planters' Association of Ceylon.

Mr. James Forbes (Jnr.).

Mr. R. G. Coombe.

Mr. John Horsfall.

Representatives of the Ceylon Estates Proprietary Association.

Mr. F. A. Bond, (Acting for Mr. D. T. Richards).

Mr. I. L. Cameron.

Mr. J. C. Kelly, (Acting for Major J. W. Oldfield).

Representative of the Low-Country Products Association.

Col. T. G. Jayewardene, V.D., M.S.C.

Representative of the Small-Holders.

Mr. D. H. Kotalawala, M.S.C.

Chairman :—Mr. James Forbes (Jnr.).

Secretary :—Mr. A. W. L. Turner.

Mr. R. G. Coombe, who had been Chairman of the Institute for approximately seven years resigned from the Chairmanship of the Institute on the 13th January, and was succeeded by Mr. James Forbes (Jnr.).

Mr. John Horsfall resigned his seat on the Board at the beginning of the year and the Planters' Association of Ceylon nominated Mr. A. G. Baynham in his place. On Mr. Baynham's resignation on the 13th July, Mr. J. D. Hoare was appointed to fill the vacancy.

Mr. J. C. Kelly who was acting for Major Oldfield proceeded on furlough as from the 28th February to the 21st May, and Mr. J. W. Thompson acted for him.

Mr. D. T. Richards returned from furlough on the 19th March, and relieved Mr. F. A. Bond.

Mr. I. L. Cameron was on furlough as from the 21st March to the 30th October, and Mr. E. L. Fraser acted for him until the 10th August, after which date Mr. R. A. Sharrocks filled the vacancy until Mr. Cameron's return.

The Hon'ble Sir Wilfrid Woods, C.M.G., Financial Secretary, an ex-officio Member of the Board since the Institute's inception, retired from the Ceylon Civil Service on the 1st June, and was succeeded by Mr. H. J. Huxham as from that date.

In terms of Ordinance No. 12 of 1925, Section 5 (1) (b), the following Members :—Major J. W. Oldfield, C.M.G., O.B.E., M.C., Messrs. R. G. Coombe, and D. H. Kotalawala, M.S.C., automatically retired from the Board on the 31st December, having completed their three years' term of office. All these three members were re-nominated for a further period of three years.

TEA CESS.

As the Institute's revenue from the cess was considerably diminished through the operation of Tea Export Control and as the present rate of cess of 14 cents per 100 lbs. of exported tea would have automatically ceased at the end of the year, the Ceylon Association in London, the Planters' Association of Ceylon, and the Ceylon Estates Proprietary Association agreed to the retention of the present rate of cess. The matter came up for consideration before the State Council, and on the 27th June, the Council passed the Amending Ordinance for the continuation of the 14 cents cess.

AUDITORS.

Messrs. Ford, Rhodes, Thornton & Co. continued to be the Institute's Auditors.

MEETINGS OF THE BOARD OF MANAGEMENT.

The Board of Management held five Meetings — 4 in Colombo, and 1 in Kandy, the attendance at Meetings averaging 9.

COMMITTEES.

Experimental Sub-Committee:—The Director, T.R.I., the Chairman, T.R.I., the Visiting Agent of St. Coombs, the Superintendent of St. Coombs, Messrs. R. G. Coombe, John Horsfall, D. T. Richards, R. H. Horne, I. L. Cameron, C. H. Wilkinson, and the Agricultural Chemist, T.R.I. (Convener).

This Sub-Committee held 4 Meetings.

Finance Sub-Committee:—The Chairman, T. R. I., the Chairman, Planters' Association of Ceylon, the Chairman, Ceylon Estates Proprietary Association, Mr. J. D. Hoare, and Mr. J. C. Kelly (acting for Major Oldfield).

This Sub-Committee held 3 Meetings.

Buildings Sub-Committee:—The Chairman, T.R.I., the Director, T.R.I., and Mr. J. C. Kelly.

Medical Sub-Committee:—The Chairman, T.R.I., the Director, T.R.I., and Mr. J. C. Kelly.

Salaries Sub-Committee:—The Chairman, T.R.I., the Director, T.R.I., and Mr. J. W. Ferguson.

SENIOR STAFF.

(a) **Director, T. R. I.:**—*Dr. Roland V. Norris.*—This officer proceeded on $6\frac{1}{2}$ weeks' vacation leave from the 22nd August to the 7th October,

(b) **Mycologist**:—*Dr. C. H. Gadd*.—This officer returned from furlough and resumed his duties on the 22nd October.

(c) **Entomologist**:—*Mr. C. B. R. King*.—During the course of the year, the Board decided, on grounds of economy, that this officer's agreement should not be renewed when it expired on the 10th December. But when the State Council sanctioned the 14 cents cess, the appointment of an entomologist was re-considered and Mr. King was offered renewal of his agreement for a further period of five years. He will resume his duties on the 28th January, 1935.

(d) **Plant Physiologist**:—*Mr. F. R. Tubbs*.—This officer proceeded on furlough on the 31st October till 6th August, 1935. His agreement was renewed for a further period of five years as from the 3rd March, 1935.

(e) **Tea Technologist**:—*Mr. J. Lamb*.—This officer arrived in Ceylon on the 12th February, and took up his new duties as from that date.

(f) **Superintendent of St. Coombs**:—*Mr. John A. Rogers* proceeded on 8½ months' leave on the 18th April, and *Mr. E. J. K. Garthwaite* was appointed Acting Superintendent and commenced his duties as from the 9th April.

JUNIOR STAFF.

Mr. J. W. Reith was appointed Field Assistant, Grade II, as from the 2nd January.

Mr. D. L. Nicol resigned his appointment as Field Assistant on the 15th January.

JUNIOR STAFF PROVIDENT FUND.

Mr. R. G. Coombe was elected as a Trustee of the above Fund at a Meeting of the Board, held on the 12th April.

MEDICAL SCHEME FOR JUNIOR STAFF.

In July, the Board adopted a scheme put forward by the Medical Sub-Committee, but agreed that it should not be inaugurated until January, 1935. Later in the year, the Junior Staff approached the Director, who in turn placed an alternative scheme before the Medical Sub-Committee. This was approved by the Medical Sub-Committee in preference to the original scheme and was adopted by the Board at a Meeting held on the 11th December.

The scheme which is to be given one year's trial from 1st January next is as follows:—

1. Monthly contributions by members of the Junior Staff of Rs. 3/- in the case of a single man and Rs. 6/- in the case of a married member.

2. The Board to contribute to the Fund on the above basis.
3. Individual accounts to be maintained for each member.
4. Payments to be limited to the amount at credit in a member's account, the member meeting any bills in excess of this amount.
5. A Member on retirement to receive back any unexpended portion of his own contribution without interest but not the unexpended portion of the Board's contribution to his account. The latter with any interest earned by the Fund, to be placed to a reserve fund to be used at the discretion of the Trustees for additional benefits. It is understood that the interest payable on a member's balance will be that derived from either fixed deposit, bank current account or investments.

SALARIES OF THE SUBORDINATE STAFF.

Early in the year it was considered inadvisable to grant Christmas gratuities to the Subordinate Staff, and the question was referred to the Salaries Sub-Committee. This Sub-Committee came to the conclusion that if the Christmas gratuity was abolished, the salaries of certain members of the Subordinate Staff would prove insufficient. The Board therefore adopted a slightly increased scale of salaries at a meeting held on the 12th April. This increment was made retrospective as from the 1st January, 1934.

JUNIOR STAFF BUNGALOWS.

During the course of the year, five Junior Staff bungalows were erected on St. Coombs Estate.

INTERNATIONAL CO-OPERATION IN TEA RESEARCH.

Mr. Shakspeare, the then President of the Ceylon Association in London visited Ceylon during the course of the year, and at his request a Conference was called for the purpose of discussing the question of international co-operation in Tea Research. This matter had formed the subject of correspondence between Mr. R. Graham, the President of the Indian Tea Association and Mr. Shakspeare. Mr. Graham's suggestion was that it might be advantageous to establish a system of centralised international research between Ceylon, India and the Dutch East Indies on the lines of present international co-operation in control of the export of tea (and to a certain extent of tea propaganda), and thereby save what he considered a great deal of overlapping in the work done by the various scientific staffs. He contended that much time would be saved and the pooling of funds would increase efficiency.

The Conference was held on February 23rd when it was considered that problems affecting the engineering and mechanical side of manufacture might in the first place be centralised owing to the heavy expenditure likely to be incurred in such work. With regard to the other problems, the Conference expressed the opinion that the fears of overlapping were exaggerated because very many problems must be approached from as many angles as possible and moreover climatic conditions necessitated separate investigations. A further conclusion reached was that the exchange of research programmes alone appeared to be practically useless unless close personal contact between institutes is promoted.

The Chairman, at a subsequent meeting of the Board, emphasised the importance of such contact and suggested that the Director should proceed to Java in order to establish a closer liaison between the Dutch Research Stations and Ceylon. The Board, while adopting this suggestion, considered that the Chairman should accompany the Director. In accordance with this decision the Chairman and the Director will proceed to Java early in 1935. They will be accompanied by the Director of the Tocklai Research Station in India.

CONFERENCES.

Conference with the Colombo Tea Traders' Association:—This Conference was held on the 31st May, when the following subjects received attention:—Tea Tasters' terms, Tasting of Experimental Teas and alleged deterioration of teas in transit to London.

OPENING OF LAND IN TEA ON ST. COOMBS.

The Institute was granted the necessary permission by the Tea Export Control Authorities to open thirty acres of land in tea. Arrangements are in hand for 10 acres to be carried out in 1936.

TEA SAMPLES.

Quarter pound sample packets of each invoice of St. Coombs teas are now forwarded to Messrs. Wilson, Smithett & Co., Ltd., London, Brokers. These samples are retained by them and are available for inspection by those interested in the Institute.

SMALL-HOLDERS.

Provision has been made for an additional Small-Holdings Officer to be appointed in 1935 for work in the low-country.

During the year under review the Board decided that prizes should be awarded to the small-holders, and to encourage them to further efforts the Board set aside funds for a competition.

VISITORS.

His Excellency the Governor Sir Edward Stubbs, G.C.M.G. and the Hon'ble the Minister for Agriculture and Lands, Mr. D. S. Senanayake, were among those who visited St. Coombs during the course of the year.

PUBLICATIONS.

The Publications of the Institute will be sent free of charge to all Proprietors, Directors, Superintendents and Assistant Superintendents of Ceylon Tea Estates over ten acres in extent, and to London and Colombo Agency Firms dealing in tea, if they register their names and addresses with the Secretary, Tea Research Institute of Ceylon, Victoria Commemoration Buildings, Kandy.

Other persons also can obtain the Publications of the Institute on application to the Secretary, and on payment of a subscription of Rs. 15/- per annum if resident in Ceylon or India, and £1-5-0 if resident elsewhere. In the case of Indian cheques, four annas should be added to cover commission.

Single numbers of *The Tea Quarterly* and Bulletins can be obtained at the rate of Rs 2-50 or 4 shillings per copy.

During the year, the Institute issued Bulletin No. 11 and *The Tea Quarterly* Volume VII, Parts 1-4.

The undermentioned publications are out of print:—

Bulletins Nos. 2, 3 and 5.

Tea Quarterly Volume I, Parts 1 to 4.

“ “ “ II, Parts 1 & 2.

“ “ “ IV, Parts 1 & 2.

“ “ “ V Part 1.

ST. COOMBS ESTATE.

Visiting Agent:—Mr. J. W. Ferguson.

Superintendent:—Mr. E. J. K. Garthwaite (acting for Mr. John A. Rogers).

A comparison between St. Coombs prices and the Colombo Market average for high grown teas is shewn in the graph at the end of this Report.

A copy of the Visiting Agent's Review on the work done on St Coombs during the year is attached.

FINANCE.

The Audited Statement of Accounts and Balance Sheet for the year 1934 are included at the end of this Report. These are now presented in a new form, the balance sheet being framed on the lines of those of semi-public concerns in England.

A. W. L. TURNER,

Secretary.

REPORT

ON

ST. COOMBS ESTATE

FOR 1934.

Superintendent:—Mr. John A. Rogers.

Acting Superintendent:—Mr. E. J. K. Garthwaite.

Climate:—Season 1934.—Weather conditions were very uncertain. Early in the year there was a very severe hailstorm which did considerable damage, and towards the end of the year rainfall was very short.

Rainfall 1934. 75·93 inches. No. of wet days 218.

Rainfall 1933. 132·70 inches. No. of wet days 249.

Decrease 56·77 inches. No. of wet days 31.

Crop:—Estimate 1934. 133,000 lbs. Made Tea.

Secured 1934. 134,285 lbs. do

Secured 1933. 132,292 lbs. do

Increase 1,993 lbs. do

The yield per acre on the old acreage was 693 lbs.

The 1926-28 Clearing, 57 acres, yield per acre was 301 lbs.

The yield was rather affected by a severe attack of Tortrix.

Cost of Production:—

Revenue Account, Estimated 55·20 cents. Actual Cost 54·26 cents.

Capital Account, Estimated 7·09 cents. Actual Cost 7·09 cents.

Crop Sales:—*Colombo*. Nett average for 1934. 66·12 cents.

Nett average for 1933. 68·53 cents.

Clearings:—The 1931 clearing, 28½ acres, was supplied and 2,959 stumps were put out.

The 1932 clearing, $9\frac{1}{2}$ acres, was also supplied and 961 stumps put out. 1931 clearing received its second treatment.

- (1). A Block had its second cut in April 4 inches above stump level.
- (2). B Block cut across to 15 inches.
- (3). C Block pruned to 10 inches, tipped to 6 inches and brought into light plucking.

Records of progress are being kept by the Scientific Staff. Growth is very good in spite of the damage done by the hail storm earlier in the year.

Cultivation:—*Old Tea*. Inorganic mixture was again used throughout the year, and, from the general appearance of the tea, there seems to be no falling-off.

Green Manures are being pushed on with every spare piece of land planted.

General:—The short rainfall was favourable for the clearing up of the swamps and quite a large amount of work has been carried through, such as draining and planting of gums which will in time make valuable timber.

J. W. FERGUSON.

REPORT

OF
THE DIRECTOR,
TEA RESEARCH INSTITUTE OF CEYLON
FOR 1934.

In December 1933 the question of the Tea Research Institute cess came up before the State Council when the decision was taken to maintain the rate of 14 cents per 100 pounds tea for *one* more year, *i.e.*, up to the 31st. December, 1934, only.

This unfortunate decision placed the Institute in a very embarrassing position in so much as we were left in a complete state of uncertainty as to the future financial position. In these circumstances it was inevitable that some dislocation of the Institute's work must follow. Not only had various contemplated lines of research to be postponed, but for several months, until the position was again more stabilised, it appeared almost certain that some of the existing activities would have to be curtailed and a reduction made in the Senior Staff.

Steps were at once taken to bring these facts to the notice of all interests concerned and eventually with the full support of the Ceylon Association in London, the Ceylon Estates Proprietary Association and the Planters' Association of Ceylon, the matter was again raised in the State Council, with the result that the cess has now been fixed at 14 cents up to December 31st., 1938. This decision was not, however, reached until the end of June.

Though the position is now stabilised for the next few years in regard to the *rate* of cess, the income that will be realised from this source still remains rather a doubtful quantity owing to the uncertainty as to future rates of restriction.

When restriction was first introduced it was anticipated that the rate would steadily fall year by year until the full quota was restored. Unfortunately this has not been realised and the *raising* of the rate in the present year to $17\frac{1}{2}$ per cent. will reduce the yield of the cess in 1935 by some Rs. 19,800 below the sum originally anticipated.

The effect of restriction and of the uncertain state of the tea market on the Institute's receipts is clearly shown from the figures given below :—

TOTAL RECEIPTS.

1932	...	...	Rs. 370,647
1933	...	...	,, 336,889
1934	...	...	,, 323,934
1935	...	...	,, 316,911 (Estimated)

A perusal of the above figures, and the fact that the immediate future in regard to the tea market and restriction is still very uncertain, will perhaps convince those who may be disappointed because certain of the Institute's activities have not been extended with greater rapidity, that a more progressive policy is not feasible until financial conditions become more normal.

CENTRALISATION OF TEA RESEARCH.

From time to time suggestions have been put forward that considerable economies could be effected by a centralisation of tea research if the necessary co-operation between the various countries concerned could be achieved.

The plea for such centralisation is usually based on the assumption that unnecessary duplication of work occurs between the various Research Stations. In view of the wide variations which occur in climatic and soil conditions in the different tea producing countries, such duplication is, however, essential.

Even in a relatively small area such as Ceylon, the Institute has found it necessary to replicate its experiments on pruning and manuring at different centres to cover different local conditions. It can hardly be expected, therefore, that results obtained in Ceylon, for example, will necessarily apply to North India or *vice versa*.

Again, in regard to pests and diseases, these vary greatly in the different countries, a disease or insect that causes severe damage in one place being absent or of little importance in another. Moreover, such attacks can only be dealt with in a satisfactory manner on the spot and this in itself would render centralised research impracticable.

A further disadvantage is that contact between the research officer and the planter would be greatly reduced except in the area where the central research station was situated.

The whole question was considered at a meeting held in Colombo early in the year but, in view of the considerations outlined above, the conclusion was reached that any centralisation of research was out of the question, except perhaps in connection with some aspects of manufacture and the chemistry of tea. In regard to the latter, it was felt that investigations on problems affecting the engineering and mechanical sides of manufacture might possibly be localised on account of the heavy expenditure involved in such work, while the more fundamental and theoretical aspects of the chemistry of tea would be of general application.

Though centralisation of research must thus be regarded as impracticable, co-operation between the various research stations is in the highest degree desirable and it was felt that this could only be satisfactorily achieved by a greater amount of contact between members of the scientific staffs.

Implementing this decision, arrangements are being made for the Director to visit Java in the near future while the Agricultural Chemist, Mr. Eden, will visit Tocklai. It is hoped that members of the Indian and Netherlands Scientific Staff will in turn be able to come to St. Coombs.

St. Coombs Estate:—In spite of unfavourable weather conditions the crop obtained, 134,285 pounds, was slightly in excess of the estimate. The nett average price realised, 66·12 cents, was, however, slightly lower than in the previous year. This was mainly due to relatively poor prices obtained at the beginning of the year. With the exception of the period between the middle of August and the middle of October St. Coombs prices were consistently above the high-grown average.

No new clearings were opened up during the year.

Buildings:—Work was commenced in the second half of the year on five junior staff bungalows and these were completed at the end of December. The cost of these quarters including site cutting, electric wiring, sanitation and drainage will amount to approximately Rs. 5,840 per bungalow.

One subordinate staff quarters was also built during the year at a cost of Rs. 1,100.

All Senior and Junior Scientific Staffs are now provided with quarters. A plant house was also constructed at a cost of Rs. 2,148.

Water Supply:—The water supply caused considerable anxiety mainly on account of its unprotected nature. Expert advice was therefore called in and proposals were sanctioned late in the year for the installation of a Jewell filter and for alterations to the distribution and storage systems.

Publications:—One Bulletin was issued during the year in addition to *The Tea Quarterly*. The demand for the Institute's publications has been well maintained and the sums received in subscriptions from those not entitled to a free issue, together with the profit realised on advertising matter, have made the publications self-supporting.

Library:—Mr. Eden was in charge of the Library during Dr. Gadd's absence on leave. Classification of all books and periodicals has been completed on the international decimal system. Additional shelving had to be provided during the year and at the present rate of increase the room will soon cease to be available for meetings.

The thanks of the Institute are due to Mr. G. Mackintosh Smith for a generous gift of many back numbers of *The Tropical Agriculturist*.

Staff:—The Director was on special home leave from the 22nd August to the 7th October during which period Mr. Eden acted. The Mycologist was on home leave from the beginning of the year to the 22nd October, his duties in the meantime being carried out by Mr. Tubbs.

The Plant Physiologist proceeded on furlough on the 31st October. During his absence his advisory work will be carried out by the Mycologist while the physiological field experiments will be in Mr. Eden's charge.

Mr. King, the Institute's Entomologist, left for England in April and at the time of his departure it was anticipated that the financial position would not permit of his re-engagement. The adjustment of the cess in June, however, and an improvement in other receipts, fortunately made it possible for his agreement to be renewed and he will return to Ceylon at the beginning of 1935.

Mr. Lamb who has been appointed to the Staff in place of Dr. Evans arrived in Ceylon in February.

Amongst the Junior Scientific Staff, the only changes were the resignation of Mr. D. L. Nicol, Field Assistant, in January and the appointment of Mr. J. W. Reith in his place.

A Medical Scheme on a contributory basis was sanctioned during the year for the benefit of the Junior Scientific and Clerical Staffs and certain members of the Estate Staff. The salaries of certain grades of the subordinate staff were revised and the scales slightly increased. On the other hand Christmas gratuities and commissions will no longer be admissible.

Advisory Work:—The number of enquiries received amounted to just over 1,600, practically the same figure as last year. 156 visits were paid to estates by members of the Staff, this figure being exclusive of routine inspections made in connection with Nettle Grub work and visits to small-holdings.

In addition lectures were given by the Staff at meetings of District Planters' Associations and of the Central Board of Agriculture.

Arrangements have been made for members of the Staff on home leave to address the Ceylon Association in London.

Fungus Diseases:—In view of the severe drought experienced during several months of the year leading to the production of conditions generally unfavourable to fungus growth, it was to be anticipated that the incidence of fungus diseases would have been diminished. There was no diminution, however, in the number of specimens sent in to the Institute for examination. There was no evidence, on the other hand, to suggest that such diseases were more prevalent than usual and no new diseases came to notice.

A considerable amount of time was spent by the Mycologist in a study of the incidence and spread of *Poria* root disease on St. Coombs where this disease is somewhat prevalent. All *Poria* patches have now been mapped and are regularly inspected. In this way any fresh cases can readily be detected. The frequency with which new centres of infection occur along estate roads and paths lends very strong support to the suggestion of the Mycologist that one of the chief agencies of dissemination is the transport of infected material through the estate by the coolies.

The investigation has also confirmed the view that the soil can remain infected for at least a year and probably longer. In this connection attention is called to the suggestion by Dr. Gadd that *Tephrosia vogelii* might be used as an indicator plant to ascertain if an area is free from infection before re-supplying. Further details will be found in Dr. Gadd's report.

Insect Pests:—The number of enquiries received in the Entomological Section showed a marked increase and 359 consignments of insect pests were received for examination and report. The dry season was undoubtedly favourable to insect attack and this factor no doubt largely accounts for their greater prevalence.

Of considerable interest was the occurrence of the Tea Seed Fly, *Adrama austeni*, which was found causing injury to exposed seed in Maskeliya.

Another new appearance was the beetle, *Micotrichia costata*, which was found feeding on mature leaves.

Occasional attacks by the caterpillars of *Prodeniya litura* were reported. This pest appears in swarms and seems to have some association with *Oxalis*. As the latter is now commonly left to grow on estates, the Institute would be glad to have confirmation or otherwise of any connection between the two.

Red Borer, *Zeuzera coffeae* attacked a considerable acreage on one estate and can be a serious pest of nurseries.

Helopeltis was reported from estates round Rakwana and Deniyaya. Fortunately this pest which causes such extensive damage to tea in Java and India shows no tendency to extend its activities in Ceylon.

Yellow Mite was frequently reported and is the most troublesome species of mites since it restricts itself to the young flush. Some severe attacks occurred in the Ratnapura district during the drought.

Tortrix was somewhat erratic in its incidence, some areas normally badly affected reporting smaller numbers, while parts of Dimbula and the Agras were heavily attacked.

Work on the control of this pest by the parasite *Trichogramma erosicornis* was held up during the absence of the Entomologist. It seems unlikely, however, that this method of control will prove economically feasible. The investigation will be continued for another season but will be finally suspended if the results then obtained are not of a more successful nature.

Collection of egg masses remains, therefore, the chief protective measure and there can be little doubt that on the whole this has reduced the incidence and seriousness of attacks. The practice is not popular, however, on account of the labour and expense involved, and there is a good deal of variation in the efficiency with which the process is carried out and in the value of the returns sent in!

A detailed study of the incidence of this pest has given a rather striking picture of the very constant periodicity of attacks, and it is by no means impossible that further investigations along these lines will lead to the conclusion that intensive egg mass collection, confined to a few relatively short periods, may be considerably more effective than collection on the present basis throughout the year. Should this prove to be the case the cost of control would of course be materially reduced.

In the Entomologist's report will be found details of incidence and severity of Nettle Grub attack in the Uva Province during the past four years.

The total acreage reported attacked in 1934 was slightly greater than in 1933 but this was entirely accounted for by a considerable increase in the Passara area where the number of outbreaks rose from 54 in 1933 to 91 in 1934. In all other parts of the Province there was a marked falling off both in the number of attacks and in the acreage affected.

Most estates concerned practise some measure of control and many are now equipped with spraying plant. Spraying with the methods at present available is, however, an expensive process, costing some Rs. 15/- per acre. Advantage was taken of the presence of the Entomologist in England to discuss with various firms the possibility of introducing improved forms, of sprayers and it is anticipated that it may be possible in this way materially to reduce the cost of control.

Agricultural Chemistry:—Work was resumed on the mechanical analysis of Ceylon tea soils. The results show that these are characterised by a high content of the clay fractions and there was a striking similarity in the figures obtained for the top and sub-soil samples. Taken in conjunction with penetrability results obtained with top and sub-soils, this can only indicate that the true top soil has been lost by erosion.

In regard to manurial experiments, the collected results for the first pruning cycle of the St. Coombs trial will be found in Mr. Eden's report. Briefly these indicate :

- (a). No response has been given to potash;
- (b). Nitrogen increased the yield in proportion to the dose used;
- (c). No significant differences have been observed between inorganic and organic types of nitrogen;
- (d). The frame of the bush responded in the same way as the flush; and
- (e). A relatively small amount of the nitrogen applied (only about 18 per cent.) is recoverable in the bush.

Analysis of the flush from plots receiving no nitrogen and 40 pounds of nitrogen per acre showed no differences of any practical importance. Similar results were obtained in the plots receiving different types of nitrogen.

In the second pruning cycle the scope of the experiment has been enlarged by the use of differential doses of phosphoric acid and results will in consequence be available in regard to all three of the chief main nutrients.

As mentioned in last year's annual report, manurial experiments have been laid down at Passara. The results so far obtained, from one year only, have not shown any significant differences when the application of phosphoric acid is increased from 30 to 60 pounds per acre or between inorganic and organic manures. Similar results were also obtained when the manure was applied two months before pruning, at pruning time or two months after pruning.

Considerable interest has been aroused during the year in regard to the Indore method of composting and the various considerations involved in applying this process under Ceylon conditions are discussed in Mr. Eden's report. The main issue is one of cost and, by courtesy of Messrs. James Finlay & Co. Ltd., it has been possible for the Institute to co-operate in a trial of this process on a reasonable scale. From this experiment costing figures will be obtained and it is hoped later to examine the agricultural value of

the material obtained. A good many other trials on a smaller scale are being made by estates in various districts and the Institute is keeping in close touch with these experiments.

The Institute has received several enquiries in regard to the risk of loss of nitrogen by the use of safaga phosphate in manure mixtures owing to the small amount of free lime present in this material. Tests carried out by the Institute under very stringent conditions have indicated quite clearly, however, that the loss, if any, is quite negligible.

Work on several new cover crops was, unfortunately, entirely vitiated by the drought.

Physiological Experiments:—Two years' results are now available for the pruning experiments in progress at St. Coombs, Peradeniya and Galatura, in which a comparison is being made between a clean prune, a cut-across and a rim-lung prune. The highly beneficial effect of the latter method at low elevations in reducing the mortality after pruning and dieback has already been discussed in the Institute's publications and this method of pruning is now being widely used in the low-country.

In regard to yield, rim-lung pruning also gives the highest results at low elevations, while at Peradeniya there was no significant difference in yield between the three methods of pruning. At the elevation of St. Coombs, on the other hand, clean pruning has given higher yields than either of the other methods.

The additional data obtained from these and other investigations lend further confirmation, if this were needed, to the view that carbohydrate reserves are the determining factor in the reaction to pruning and in the production of new growth. The amount of carbohydrate found in the roots of bushes eighteen months from pruning increases fairly regularly with elevation, raising by about 2 per cent. for each 1,000 feet of elevation.

The nitrogen supply in the roots on the other hand shows little variation with elevation and there is no evidence that this is an important factor in the occurrence of dieback.

Plucking experiments have been in progress to compare the effect of taking 7 and 14 days rounds, the standard of plucking being the same in each case. No significant difference in quality was found between the teas thus obtained. Yield was, however, materially reduced by taking the longer round and this could serve as a useful restriction method.

Tea Manufacture:—The Tea Technologist joined the Staff in February but several months were necessarily spent in acquainting himself with local conditions.

A very large number of enquiries was received in the Biochemical Section and 902 batches of tea samples were sent in for examination. The majority of these were in connection with firing tests, a smaller number for tannin and caffeine determinations and one sample for estimation of chlorophyll which occurs to the extent of about 1 per cent. in made tea.

Judging from the enquiries received by the Institute firing seems to present more difficulties than the other stages of manufacture and, in the past year particularly, a good deal of trouble has evidently been experienced by some estates in obtaining teas with good keeping qualities, complaints of "fading out" having been more common than usual.

Two conditions have to be satisfied in drying, the inactivation of the ferments present in the leaf and the reduction of the moisture content to a reasonable figure. Failure to achieve either of these results will result in a tea of inferior keeping qualities.

Drying alone, even at low temperatures, will render the ferments temporarily inactive but does not necessarily destroy these. This accounts for the well-known fact that teas dried at low temperatures do not keep well, the reason being no doubt that when such teas absorb moisture, the ferments again come into action and the teas "fade out".

In the case of teas which have been correctly fired the chief cause of deterioration is the absorption of moisture either before packing or during transit but this can be avoided by careful storage and packing.

It is certainly significant that in practically every case in which the Institute has been called in in reference to complaints of teas not keeping, it has been found that the factory concerned has had no moisture determination balance and has thus been unable to keep any proper check on its firing or on the moisture content of the teas when packed.

A check of this kind is eminently desirable since the Institute has ample data to show that, with the present methods of packing, teas very readily pick up additional moisture during transit. This factor and the whole question of deterioration is under close investigation.

The Institute formerly recommended that teas should be packed with a moisture content of 5-6 per cent. but, in view of the above considerations, it is now suggested that a rather lower figure, say 4-5 per cent. will be safer. This, however, raises another difficulty, since there is reason to believe that if the tea be dried to too low a figure, it does not mature properly. Nothing is yet known, however, as to the nature of this maturing process nor as to the agencies by which it is brought about, *i.e.*, whether it is purely a chemical change or whether biological factors such as ferments are concerned.

In regard to the actual firing process, the most common fault is too low an exhaust temperature and it is necessary to stress that this should not be lower than 120°F.

The Institute has spent a good deal of time in a study of firing conditions but is greatly handicapped at present by the inadequacy of its small-scale firing machinery. Plans are under discussion for renewal of this plant as soon as financial considerations permit.

Plans had been made for a study of withering under different temperature conditions. For this work the Institute had been offered the use of a special air conditioning plant by an American firm. After considerable delays this plant arrived in Ceylon late in the year but has unfortunately proved unsuitable for the purpose intended.

Many methods have been suggested for checking the withering process. Of these the only one which seems likely to give reliable information is the actual determination of the moisture content of the leaf. The time taken for making such determinations, however, has so far prevented this method from being adopted. Attempts have therefore been made by the Institute to devise an apparatus capable of yielding more rapid results. A method suitable for laboratory conditions has been worked out but this still needs considerable adaptation before it can be considered suitable for general factory use.

Some difficulty has been experienced during the cold season in obtaining good fermentations with the leaf from the Institute's small-scale rollers. Investigation of this has shown that temperature is the controlling factor. Owing to the small amount of leaf in these rollers the temperature of the leaf remains much lower than in normal plant and the onset of fermentation is delayed. Marked improvements were obtained by fermenting these small dhools at a temperature of about 65° and it is likely that higher temperatures still would be preferable. Work in other countries suggests that a temperature of about 70-72° is the optimum. If this be so, then it is probable that fermentation on many estates at high elevations in Ceylon is carried out at too low a temperature during the cold season. The point is under investigation.

Plans have been completed for the alterations to the small rollers envisaged in the Report for 1933 and an order has been placed for the necessary plant. Each of these rollers will now be on independent electric drive and equipped with recording apparatus to enable full data on rolling to be accumulated.

Complaints are often made as to the complexity of Tea Tasters' terms and doubts expressed as to the true meaning of many of these expressions. A Conference was accordingly held in Colombo between representatives of

the Institute and of the Tea Traders' Association when the whole matter was discussed. While it was not possible to arrange for any material simplification of these terms, an agreement was reached in regard to their interpretation and a glossary has accordingly been published in *The Tea Quarterly*.

It is hoped to prepare a similar glossary for the terms used by London tasters.

Small-Holdings:—The Small-Holdings Officer visited 137 holdings during the year and considerable progress has been made in demonstrating improved methods of working.

A competition amongst small-holders in Uda-Palata has been organised in co-operation with the District Agricultural Committee.

In the latter part of the year work on the holdings was largely disorganised by the prolonged drought and the malaria epidemic which ensued.

It is of interest to consider what has been the general effect of restriction on the small-holders in the area dealt with by the Small-Holdings Officer. The determining factor is of course the right to sell coupons. It is estimated that about 80 per cent. of these coupons are sold immediately they are received.

About forty per cent. of holders have continued to maintain their gardens in good condition, those who have sold their coupons often resting the tea. Another twenty per cent. have been forced to utilise the proceeds from coupons in meeting debts. The remaining forty per cent. have simply neglected their holdings through the lack of any incentive or desire to work when an income was assured without taking this trouble.

The nett result would seem to be that while nearly all holders are temporarily better off under restriction, a considerable proportion stand to lose in the long run, owing to their failure to maintain their gardens in a reasonable condition.

The income derived from the sale of coupons has, however, undoubtedly helped many small-holders to get through the difficult times brought about by drought and malaria.

Bought leaf factories have suffered severely, being unable to secure adequate supplies of couponed leaf, and this had led to a very considerable reduction in the labour employed by such factories.

It is considered that the work in small-holdings in the Gampola area has been sufficiently successful to justify the appointment of a second Small-Holdings' Officer. This appointment will be made early in the new year and the officer selected will probably be stationed in the Baddegama district.

General:—The Director was appointed an *ex-officio* member of the newly-constituted Board of Agriculture and also served as a member of the Committee appointed by H. E. the Governor to report on the facilities for research available in Ceylon.

Acknowledgments:—Our thanks are due for the facilities which have again been placed at our disposal at Peradeniya, and on Gonakelle and Galatura estates for major field experiments.

Colombo tea tasters have given invaluable help in reporting on experimental samples and we are especially indebted to Mr. R. H. Horne for his assistance in this matter.

Mr. J. W. Ferguson and Mr. F. J. Whitehead have, as always, given the Staff invaluable help and advice and we have to acknowledge the co-operation and hospitality received from planters in every district.

The reports of the Scientific Staff are appended.

ROLAND V. NORRIS,

Director.

REPORT OF THE MYCOLOGIST FOR 1934.

Staff:—There has been no change in the Staff of the division during the year. The Mycologist was on leave until October 22nd, 1934 during which time the Plant Physiologist, Mr. F. R. Tubbs, had charge of the division.

Advisory:—255 letters were received and 250 despatched. 123 consignments of diseased plants were received; of these 104 were tea. The remainder consisted of miscellaneous green manure plants and shade trees commonly grown on estates. After my return from leave visits were made to the Badulla, Balangoda, Hewaheta and Uda-Pussellawa districts.

No new disease of any importance has been recorded during the year, nor was there any undue prevalence of the known diseases. The most outstanding character of the year from a phytopathological point of view was the mortality of tea bushes resulting from abnormal drought, particularly in the 'dry' areas. Special mention is made of this later. Drought conditions, in general, are not favourable for the rapid propagation of most disease causing fungi, but if any decrease in the incidence of disease occurred in the field it was not reflected in the number of specimens submitted for examination, as there was a slight increase over the previous year's total.

Poria Root Disease:—The existence of numerous Poria patches on St. Coombs has afforded an opportunity of making a detailed study of this disease in the field. This work was started in 1933 when all areas containing dead or dying bushes were marked and numbered. In 1934 other areas containing the disease were located. These are not new patches in the sense that infection is recent; they are areas from which bushes had previously been removed but in which no death had occurred to our knowledge in 1933. It is evident, therefore, that under St. Coombs conditions the fact that no death has occurred in a patch for 12 months is not a safe criterion that the fungus in the soil is inactive.

It soon became evident that fairly accurate maps of each patch would have to be made in order to record the history of the plots, the date of removal of particular bushes and their condition of removal. The mapping of these areas has occupied much time of the Assistant to the Mycologist, but already they are proving of value.

Periodic visits are made to all patches, and the Superintendent reports all diseased bushes he sees on his rounds, yet it has been found on comparing the plot with the plan that a bush marked in the plan has apparently disappeared. An investigation of the site shows that the aerial portion only has gone (for firewood) while the diseased roots are still in the ground. This is likely to occur on any estate where the labour force is short of firewood and dependent on tea prunings and such like material for fuel. But

it will be realised that when the bushes are removed in this way there is nothing visible to attract the attention of the disease gang, and so diseased roots remain in the ground to cause further infections.

The risk of new centres of infection being started from pieces of diseased roots finding their way into healthy tea has frequently been emphasised by this division. A common source of such infections is the transport of diseased material from the site for destruction, and the use of closed bags is strongly advocated for such work. If further proof is needed for the necessity for such precautions it is to be found in the fact that the smallest, and consequently youngest, Poria patches are to be found on roadsides or on short cuts along which bushes have been carried for destruction. The removal of dead bushes for firewood affords another source of danger. Only the badly diseased bushes with much rotted taproots are easily removed, and these are most sought after. If an adhering root or piece of rotten wood falls during transit it is of no interest to the cooly, but it is almost certain that that wood will ultimately find its way into the tea with subsequent risk of infection.

Mention has already been made of the long time interval which may elapse between the death of one bush and the next, and it is constantly impossible to state with any certainty how long an area should be left bare, after treatment, before supplies may safely be planted out. Use may be made of the fact, however, that Poria will attack *Tephrosia vogelii*. To determine whether an area is free of the disease, *Tephrosia vogelii* might first be planted and if it arrives at the flowering stage without being infected it may safely be assumed that the area is free. Experiments to test the value of this suggestion will be carried out on selected areas.

Drought:—The drought of 1934 was of a severity unprecedented in many districts and gave rise to problems not normally encountered. A full account of the effect of drought will be given at the Conference in March, and reference should be made to the proceedings published in *The Tea Quarterly*. Here brief mention only will be given of some of the observations made

Experiments were carried out at St. Coombs to determine the normal water requirement of tea, and it was ascertained that under these conditions an acre of tea gets rid of water by varying amounts daily dependent upon climatic conditions; the maximum determined being 10 tons per acre per day. If this figure is accepted as an approximation of the water requirements of tea under drought conditions it will be realised that during a rainless month something like 300 tons of water will be removed from the soil. That is an equivalent of 3 inches of rainfall.

Examinations of rainfall records were made of two estates in the Balangoda district which were very severely affected by the drought. For the five years ending 1933 the mean monthly rainfall during the months July, August and September for these two estates amounted to 3.20 and 3.04 inches — amounts approximating the calculated normal requirements. In 1934 the total amount for the three months reached only 1.96 and 1.65 inches respectively, giving means of 0.65 and 0.55 inches per month. It is not surprising, therefore, that the prolonged drought had a marked detrimental effect on these estates.

The bushes to show the effects of drought first were those growing in shallow soils, near slab rocks or near places normally wet; the older bushes from pruning; and those growing in sheltered places. The age from pruning materially affects the total leaf area, *i.e.*, the transpiring surface, and consequently the demand for water from the soil. The fact that uncultivated tea such as may be seen in certain small-holdings, and tea situated on slopes exposed to the wind suffered less in general than cultivated tea and bushes grown in hollows or sheltered by the windbreaks, suggests that there may be marked differences in the extent of the root range of the bushes. In the absence of cultivation and manuring, the roots are forced to explore greater volumes of soil to obtain their food requirements, and this greater root range stands the bushes in good stead in times of drought. As regards the survival of cultivated bushes on exposed hillsides, one is inclined to the assumption of a tuitional effect. One assumes that these bushes normally feel the effect of the annual dry season more keenly than those in more protected places, and that the annual succession of relatively mild drought conditions has resulted in these bushes developing deeper root systems. Consequently, during more severe drought the bushes have a larger volume of soil from which to extract water, and so are able to stand up longer to the severe conditions. Verification of such assumptions, however, can only be obtained by close study and comparison of the root system of bushes growing under varying climatic conditions.

Such observations should not be interpreted as a valid argument against cultivation in general, unless acceptance is also made of the premise that severe droughts such as that of 1934 are to be expected at very frequent intervals. A better interpretation can be made in favour of deep cultivation.

The recovery of affected bushes was very slow even when a great part of the wood frame was not dead. In many cases the whole of the aerial portion of the bush was dead, but so long as the region at, and just below the ground level was alive there was every possibility of recovery from that area. In other cases the taproot had died back for some distance below ground level and the bases of larger lateral roots were involved. In such cases there was little or no hope of an effective recovery.

The examination of individual bushes to determine whether they are likely to arise is obviously a lengthy job demanding skilled observation, and quite impracticable under estate conditions. This division has, therefore, consistently recommended that a lengthy interval be allowed for recovery. Only after recovery has started, and the location of new shoots is evident should pruners be put through the fields to remove dead branches. Not until this work is completed should gangs commence the uprooting of apparently dead bushes. If it is then found that a fair proportion of these are alive at the collar, the work should still further be delayed, or alternatively the bushes alive at ground level should be collar-pruned and the others uprooted.

Wood Rot:—It is well known that when young tea, infected by shot-hole borer is pruned, the pruning cuts frequently exhibit a discolouration suggestive of incipient wood rot although such discoloured areas are not directly connected with any rotted areas existent in the young plant. The beetle, after making her gallery, plants in it a fungus known as the 'ambrosia fungus' on which the young feed. Questions naturally arise concerning the ambrosia fungus and its possible causation of wood rot. The gallery itself is also a possible point of entry for other fungi capable of attacking wood, but as yet there is no definite evidence to support such a contention. Investigations have been started, which it is hoped will provide definite answers to many such questions.

Tea Cider:—Interest in this beverage has gradually diminished and few enquiries for cultures are now received. It has been placed on the market by the New Colombo Ice Co., Ltd. from whom supplies may be obtained.

C. H. GADD,
Mycologist.

REPORT OF THE ENTOMOLOGIST FOR 1934.

Staff:—The Entomologist proceeded on home leave on the 4th April, and the Plant Physiologist was in charge of the division from that day till the end of October when he proceeded to England on furlough. From November onwards the advisory work of the division was carried out from the Passara Sub-Station.

Advisory Work:—Correspondence of the whole division, which includes the Passara Sub-Station, was as follows:—469 letters received and 509 despatched; 359 consignments of insect pests of tea, green manure and shade trees received for examination and report.

The Passara Staff alone made 78 visits to estates in Uva, 96 field inspections round Passara, and 75 days were spent in carrying out insecticidal tests and supervising spraying campaigns in the Passara district.

Passara Sub-Station:—Work at this station originally consisted of an investigation into the Nettle Grub problem. With retrenchment in 1933 it was decided to curtail the entomological work and develop the station in other directions — mainly agricultural.

During 1934 the staff which consisted of two officers — the Assistant Entomologist and a Field Assistant — was called upon for the following duties:—

1. Test the efficacy of insecticides against nettle grubs.
2. Supervise spraying campaigns.
3. Advisory work *re* control of nettle grubs and other pests of tea in Uva.
4. Supervise two series of manurial experiments on Gonakelle for the Agricultural Chemist.
5. Carry out a "dieback" experiment for the Plant Physiologist.
6. Carry out a sulphur dusting experiment for the Tea Technologist.
7. Supervise the routine work of the Entomological division during the months of November and December. This included the laying out of an experiment at St. Coombs, towards the end of December, to determine the rate of spread and efficiency of the parasite *Trichogramma* in the eggs of Tortrix.

The following are some of the more important pests of tea which were reported during the year under review.

CATERPILLAR PESTS.

Bagworms:—The two most reported species were *Psyche albipes* and *Chalio doubledayi*. As mentioned in the Report for 1933 these two species once again made their appearance between the months of June and August.

Cutworms:—*Agrotis ypsilon* was reported twice from Norwood as causing considerable damage to tea nurseries. The application at dusk of a poison bait containing Paris Green is the most effective check on these nocturnal marauders.

Army Worm:—Caterpillars of the Noctuid *Prodenia litura* appear occasionally in swarms or “armies” on tea. In every case reported of late the caterpillars were said to have first fed on *Oxalis* growing between the tea. Hand picking of the larvae was found a more practicable measure of control than spraying with a stomach-poison.

Red Slug:—Caterpillars of the Zygaenid *Heterusia cingula* were usually sent in with nettle grubs which they resemble to a certain extent in appearance as well as the damage they cause by defoliating mature leaves. Red Slug caterpillars have two very efficient parasites and both appeared during the year.

- (1). *Apanteles heterusiae* — a Braconid larval parasite and
- (2). *Exorista heterusiae* — A Tachinid which emerges after the parasitised larva has succeeded in making its cocoon.

Red Borer:—*Zeuzera coffeae* was reported as usual during the latter half of the year. On an estate close to Badulla a considerable acreage was attacked. In tea nurseries this borer is a serious pest since the only remedy is the destruction of all affected plants. In older tea pruning of attacked branches and probing of the tunnel containing the boring larva are the only measures which can be recommended at present. No effective indigenous parasite has as yet been recorded.

Tea Leaf Pyralid:—*Piesmopoda rufimarginella* appeared in considerable numbers on a few estates in Passara during May, June and July. According to Hutson “the presence of the pest can usually be detected by the small masses of dead leaves near the top and in the middle of the bushes, and badly attacked bushes may have a thinned out and ragged appearance due to partial defoliation.” A couple of *Braconid* parasites, not yet identified were bred from larvae collected in the field. This is a first record. The Lymantriid *Nygmia flava* and the Arctid *Nepita conferta* continue to be reported as Nettle Grub (*Limacodidae*). The former, however, appears sporadically in tea and is capable of a certain amount of defoliation, while the latter confines its attentions to lichens and mosses only.

BEETLE PESTS.

White grubs (*Anomala* sp.) were reported to be damaging plants in a nursery in Koslande.

Microtrichia (*Lachnosterna*) *costata* Walk., a Melolonthid beetle, was recorded as feeding on mature leaves. This is a first record.

BUG PESTS.

Brown Bug:—*Saissetia hemisphaerica* Targ. was the scale sent in most frequently for report. Towards the end of the year, due to a weak North-East Monsoon, the pest became rather wide-spread on an estate in the Nuwara Eliya district. A few weeks later, due to a slight change in the climatic conditions, the entomogenous fungus *Cephalosporium* set in and checked the second generation of scales from establishing themselves. The investigation of *S. hemisphaerica* and *Coccus viridis*, Green Bug, is still in the hands of the Department of Agriculture.

Helopeltis as usual was reported from estates in the south-western portion of the Island where it confines itself to the tea round Rakwana and Deniyaya.

The Fulgorid *Ricania fenestrata* was reported from the Kelani Valley.

FLY PESTS.

Damage by *Oscinis theae*, the Tea Leaf Miner, is frequently mistaken for some disease due to the silvery grey appearance caused as a result of the larvae mining their way beneath the epidermis. An important record during the year was the presence of the "Tea seed fly" *Adrama austeni* from Maskeliya where it was causing injury to exposed seed in a germinating bed.

MITES.

Of the four species of mite which affect tea, Yellow mite (*Tarsonemus translucens*) causes the planting community most concern and is consequently the species most reported. Unlike the other three species, *i.e.*, Scarlet, Pink and Purple mite, which confine their attentions to mature leaves, Yellow mite restricts itself to the flush and therefore its damage during a period of prolonged drought is apt to cause alarm. Due to the failure of the South-West Monsoon, estates in the Ratnapura district were badly affected. As a measure of control estates resorted to spraying with sulfinette and sulphur dusting.

The comments of a Superintendent who experimented with both these methods are worth recording.

"The sprayed bushes recovered the best, so long as they were sprayed correctly. I found that quite a number of the branches showed no signs of sulfinette.

"The area dusted by machine (Four Oaks dusting machine) came next in order of merit. (This was dusted with a 3 to 1 mixture of sulphur and lime).

"The hand dusted area was last in order of merit.

"My observations lead me to believe that the machine dusted area recovered better because the dust came from underneath, and not on top as by hand. On the hand dusted bushes all the top leaves appeared to be free of mite but the ones 2 or 3 inches below the surface were not free."

He preferred spraying for untipped bushes and hand dusting with more sulphur for tea in plucking.

PESTS OF GREEN MANURES.

Leaves of dadaps (*Erythrina lithosperma*) were defoliated by the following:—

Notolpbus posticus, the small tussock caterpillar; the Lasiocampid *Taragama dorsalis*; the Sphingid *Acherontia lachesis*, and *Aularches miliaris*, the spotted locust.

Crotalaria anagyroides was reported to be attacked by the Capsid *Ragnus importunitas* and a species of Green Fly (Jassidae). *Albizzia* sp. were attacked by the caterpillars of the Yellow butterfly *Terias silhetana* and the scale *Phenacoccus iceryoides*. Gliricidias were affected mainly by Coccids and their presence was invariably undetected till the sooty mould *Meliola* manifested itself on the foliage and tea beneath. The two species of scales more frequently seen were *Pseudococcus virgatus* and *Coccus viridis*.

TABLE I.
Nettle Grubs in Uva, 1931-1934.

Planting District		1931	1932	1933	1934
Badulla	Outbreaks	90	64	79	58
	Acreages affected	4,478	5,264	4,000	2,608
Haputale	Outbreaks	26	13	5	2
	Acreages affected	2,165	554	263	2
Madulsima	Outbreaks	21	2	12	5
	Acreages affected	1,215	14	518	63
Passara	Outbreaks	84	49	54	91
	Acreages affected	8,719	4,681	3,004	6,614
Uva	Outbreaks	221	128	150	156
	Acreages affected	16,577	10,513	7,785	9,287

NETTLE GRUBS.

Returns:—Estates in Uva continued to send in the monthly postcards indicating whether they had outbreaks or not. With the exception of a couple of estates in the Haputale district, which, for some reason or other, ceased to send in this monthly Nettle Grub card, the response from the whole of Uva was very satisfactory. The laboratory at Passara was, however, always informed of every outbreak. Summaries of these records

TABLE II.

NETTLE CRUBS IN UVA 1934.

Planting District.	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Badulla												
Outbreaks	3	4	5	5	3	7	7	6	5	6	3	3
Acreages affected	101	134	144	185	84	436	483	241	184	206	265	145
Haputale												
Outbreaks	—	—	—	1	1	—	—	—	—	—	—	—
Acreages affected	—	—	—	1	1	—	—	—	—	—	—	—
Madulima												
Outbreaks	—	—	—	—	2	2	—	—	—	1	—	—
Acreages affected	—	—	—	—	20	27	—	—	—	16	—	—
Passara												
Outbreaks	4	4	4	5	8	9	11	10	10	9	8	9
Acreages affected	438	382	166	649	743	690	890	619	749	430	389	469
Uva												
Outbreaks	7	8	9	11	14	18	18	16	16	16	11	12
Acreages affected	539	516	316	835	835	1,153	1,373	860	933	652	654	614

were sent monthly to the Chairman of the Uva Planters' Association and the Controller of Plant Pests, Peradeniya, and these two officers were in this way kept advised of the situation in Uva.

Outbreaks:—There was a rise in both the number of outbreaks and areas affected during 1934 for the whole of Uva; the majority of these outbreaks occurred round Passara. The Badulla, Haputale and Madulsima districts, however, continued to be less affected than they have been for the last four years. This is clearly indicated in Table I which gives a summary of data recorded for the whole of Uva since 1931.

Table II indicates the situation monthly for the four important planting districts in Uva during 1934 only.

Control:—In 1932 Nettle Grubs were declared a pest under the Plant Protection Ordinance No. 10 of 1924 on the initiative of the Uva Planters' Association and it is gratifying to record that practically every affected estate during the year under review practised some measure of control. In addition to the prescribed measure of collecting and destroying larvae and cocoons, those estates which were equipped with the necessary machinery carried out extensive spraying campaigns. Another pleasing feature was the ready co-operation of estates round Passara which never hesitated to loan their machines to neighbouring estates which needed them.

Spraying is, unfortunately, considered an expensive item for the simple reason that the operation is a slow process. A dozen pneumatic sprayers — each with a capacity of $2\frac{1}{2}$ gallons — are just able to cover an acre of tea in a day and the operation on the average costs about Rs. 15/- per acre. (The spray consists of a pound of laundry soap dissolved in 20 to 40 gallons water, the concentration being diluted as the larvae develop).

During 1935 experiments will be carried out with a more portable type of machine which has been selected by the Entomologist during his furlough in England. If this machine turns out a success, spraying will be a more feasible and economic proposition under estate conditions than it is at present.

BIOLOGICAL.

With the absence of the Entomologist during a great part of the year this phase of the investigation was not proceeded with, but the subject will receive further attention when the Director of the Tea Research Institute visits Java early in 1935.

C. B. REDMAN KING,

Entomologist.

REPORT OF THE PLANT PHYSIOLOGIST FOR 1934.

Correspondence:—216 letters were received and 250 were despatched.

Visits:—21 visits to estates were made during the year, and 7 to sub-stations.

Acting:—The Plant Physiologist was in acting charge of the Mycology Department until October 22nd. In addition, charge was taken of the Entomology Department, on the Entomologist proceeding on leave, from April 4 to October 31st.

Leave:—The Plant Physiologist proceeded on home leave on October 31st, the field experiments are overlooked by the Agricultural Chemist, while the Mycologist is in acting charge of the laboratory activities.

Sub-Stations:—As before, an assistant was maintained on Galatura Estate, Kiriella, with the assistance of the owners, agents and superintendents. The extension of the pruning experiments at Peradeniya for a further term of two years has been rendered possible by the help of the Director of Agriculture and his Staff.

To all those who have assisted in the provision of facilities for these outstation experiments the Institute owes cordial thanks. It is undoubtedly the case that the investigation of the many factors influencing the pruning of tea would have been impossible save for their co-operation.

Carbohydrates as a Factor Affecting Recovery From Pruning.

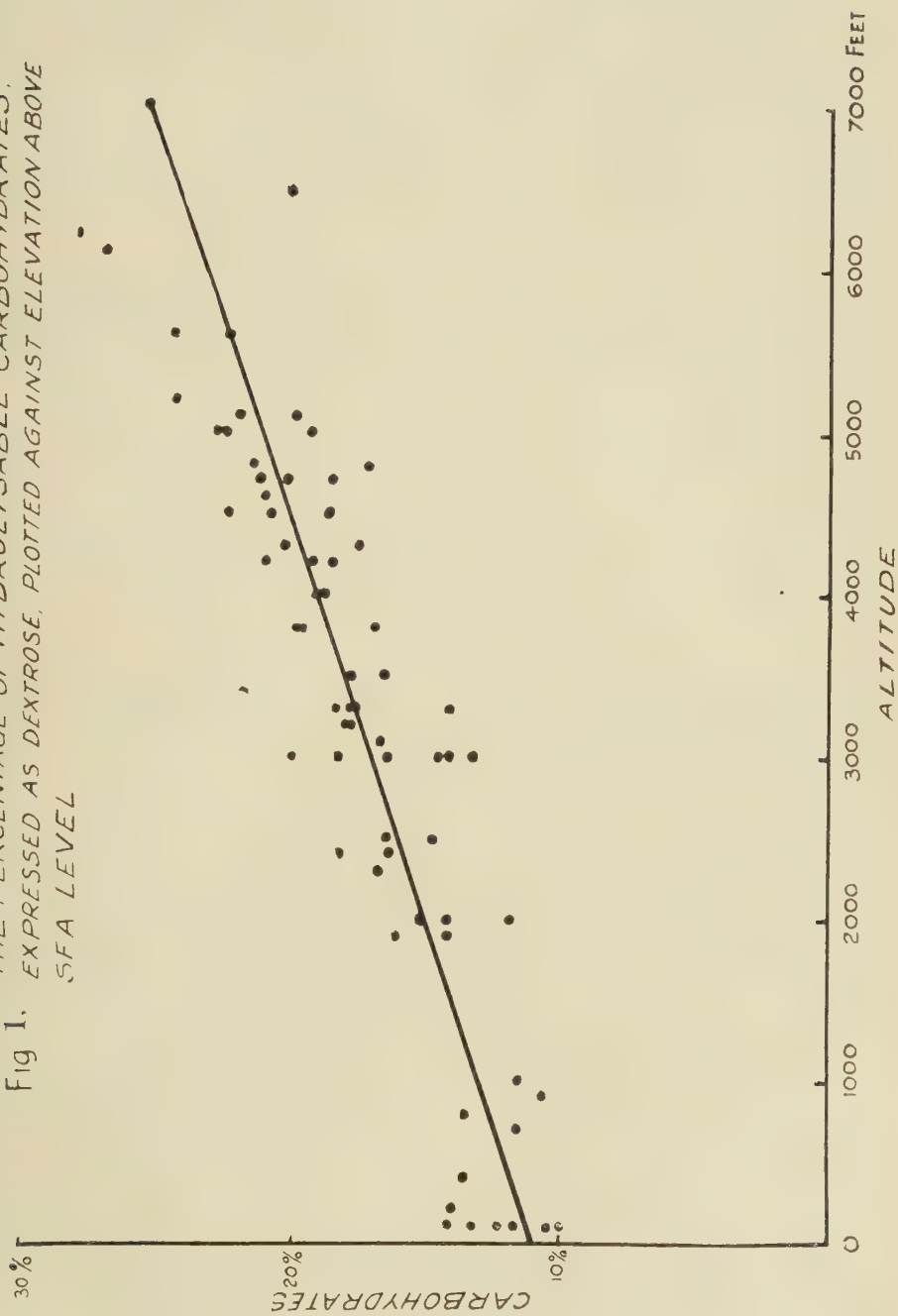
During the year analyses were made of the total hydrolysable carbohydrates in sixty-nine root samples from fields eighteen months from pruning situated at elevations of 6,500 to 100 feet above sea level. The root material, dried and ground to pass a 40-mesh sieve, was hydrolysed for 2·5 hours with 2·25 per cent. hydrochloric acid in a water bath. Reducing substances were estimated by Fehling's solution.

The results are shown in Figure I, the percentage of total carbohydrates, expressed as dextrose, being plotted against elevation. It is noticeable that the values show a steady tendency to increase with elevation. The straight line expressing most accurately this tendency is shown in Figure I, its equation being

$$Y = 11\cdot17 + 0\cdot20X$$

where Y is the percentage of total carbohydrates expressed as dextrose, and X is the elevation above sea level in hundreds of feet. Thus, on the

Fig 1. THE PERCENTAGE OF HYDROLYSABLE CARBOHYDRATES,
EXPRESSED AS DEXTROSE, PLOTTED AGAINST ELEVATION ABOVE
SEA LEVEL



average, the percentage increases by 2.0 per cent. per thousand feet additional elevation above sea level.

If the incidence of the *Diplodia* disease of tea is accepted as being conditioned by the supply of carbohydrates during the period of recovery from pruning, the existence of this marked relationship between the carbohydrate reserves of the bush and elevation provides an explanation of the occurrence of the disease only at the lower elevations in Ceylon.

Similar analyses were also made on root samples taken at the tipping stage from the lung pruning experiment described in the Annual Report for 1933. The mean percentages of carbohydrate found were as follows:—

Number of Lungs	0	3		6	
Time of removal	—	Early	Late	Early	Late
Percentage	10.62	13.39	13.41	13.42	12.90
Mean	10.62	13.40		13.16	

The only significant difference is that due to the number of "lung" branches. The significant difference between treatments is 2.32 per cent, and comparing the means it is seen that clean pruning resulted in a smaller content of "total carbohydrates" in the roots at the tipping stage than did either form of "lung" pruning, in spite of the much greater amount of new growth that was produced on the lung pruned bushes. The very close relationship during the first year after pruning between the production of new shoots and the leaf area upon the bush, which has already been demonstrated, renders it probable that the whole of the carbohydrates manufactured by the leaves on the "lung" branches, over and above that required for their own metabolism, was utilized in the production of the enhanced amounts of new growth. If this was the case, the difference must be due to clean pruned bushes utilizing a greater proportion of the reserve substances than did those on which leaves were left. Microscopic examination revealed that starch was present in all the samples, but in very small amount, only a few grains being detectable.

The rate of production of new growth after pruning must also play a part in influencing the recovery from pruning. Rapid production of new leaves after pruning reduces the period during which the respiration of the bush is maintained only on reserves, and hastens the attainment of a positive carbohydrate balance.

An experiment was performed at Talawakelle to determine the influence of the type of pruning upon the subsequent leaf area. The mean dry weight of leaves per bush, derived from totals of one hundred bushels, were :—

Days from pruning	Lung Prune		Total	Cut Across		Clean Total
	Lungs	Remainder		Total	Total	
0	54	2	56	25		1
27	54	2	56	32		1
54	62	2	64	39		2
81	103	22	125	102		26
108	129	51	180	162		65

The leaf weight of the cut across bush commences to increase earlier than that of the clean pruned bushes, or of the interior of the lung pruned bushes. This is due to the more rapid bursting into growth of buds on the younger and thinner branches which remain on the bush when it is cut across. The actual increase attained in 108 days is also far greater due partly to the earlier start and partly to a greater number of primary shoots being produced. Calculations of the number of shoots per bush tipped in 1932 on the pruning plots at St. Coombs gave the following results.

Lung Prune	Cut Across	Clean Prune
56	96	48

The difference between the number of shoots tipped on the lung pruned bushes and on the clean pruned bushes is not significant, but cutting across resulted in significantly more primary shoots being produced than did either of the remaining treatments.

Caution is, as always, necessary in applying the results of pruning experiments conducted at high elevations to low elevations. While at low elevations cutting across results in distinctly more rapid initiation of new growth after pruning, than do other types of pruning, the *number* of primary shoots is not significantly increased. The numbers of primary shoots per bush tipped at Kiriella in 1932, at an elevation of 200 feet, were :—

Lung Prune	Cut Across	Clean Prune
44	42	39

None of these values differs significantly from the others.

The reason for this difference in reaction to cutting across at Talawakelle and at Kiriella is probably to be found in the occurrence of dieback at Kiriella.

The average weight per unit length of the branches remaining on cut across bushes is considerably smaller than on clean or lung pruned bushes owing to the removal of all thin branches in the two latter methods of pruning. The number of buds removed from participation in the production

of new shoots by the occurrence of a given weight of dieback is therefore greater on cut across bushes than on lung or clean pruned bushes. Thus the effect of dieback in the cut across plots is to reduce the number of buds available for the initiation of new growth disproportionately to the amount that occurred. It is suggested that owing to the incidence of dieback the difference between the number of buds available for the initiation of new growth on cut across bushes and that on clean pruned or lung pruned bushes at Kiriella was far smaller than at Talawakelle.

Further data demonstrating a close relation between leaf area and the production of new growth after pruning were acquired during 1933.

The mean dry weight of flush harvested from nine groups of twenty bushes, clean pruned in nine periods of sixty three days from tipping was recorded. At the end of each period, the whole of the leaves were stripped from the group under observation, dried and weighed. The data collected enabled the correlation between the weight of new shoots harvested and the weight of leaves upon the bush at successive intervals over a period of 567 days from tipings to be calculated.

The weights in grammes were:—

Period.	Flush.	Leaves.
1	15.60	88.46
2	24.04	164.20
3	29.93	229.06
4	30.11	202.75
5	34.54	260.36
6	36.43	342.46
7	36.84	400.97
8	28.95	389.18
9	37.57	444.97

Examination of the data shows that while there is close agreement between the variations in leaf weight and flush weight in the first five periods, the latter four show no trace of this. The values of the correlation coefficient over the two groups of periods are $r = +0.99$ and $r = +0.10$ respectively, the latter value being quite insignificant. Thus during the first five periods, three-hundred and fifteen days, the leaf weight and the weight of new shoots produced are closely connected. This connection can be explained in two ways, either the carbohydrate supply is a limiting factor in the production of new growth, or the environmental factors act exactly alike on flush production during a period of sixty-three days and on the weight of unplucked leaves grown in the much longer period between pruning and stripping. The latter is inherently improbable, and one is led to the conclusion that

carbohydrate supplies are at a minimum for more than a year after tipping when the bush is regularly plucked. If this is so, a sufficiently large leaf area to enable the laying down of carbohydrate reserves is only attained after this.

This deduction leads to the conclusion that the effect of the presence of large numbers of leaves on lung pruned bushes during the recovery period may be explained by carbohydrates being in minimum. The extra supply of carbohydrates derived from the process of assimilation by the leaves on the lung branches results in increased growth and decreased dieback.

Nitrogen as a Factor Affecting Recovery from Pruning:—The large increase in the production of new growth at Kiriella produced by lung pruning renders the mineral relationships in the plant of interest. Unfortunately no analyses of the new growth were made, but the fact that an average of 4.62 pounds of tipplings were removed per hundred bushes from those in which six branches per bush were left unpruned compared to only 2.19 pounds in the case of clean pruned bushes, make it probable that considerably more mineral substances were utilized in the production of new growth in the former than in the latter.

Analyses of the total nitrogen, by the modified Kjeldahl method, in the roots at the time of tipping indicate no significant differences between the pruning treatments. The mean percentages found were:—

Clean	3 Lungs	6 Lungs
2.12	1.99	2.11

It appears, therefore, that the additional nitrogen required for growth must have been absorbed by the lung pruned bushes.

Clean pruning has been found to reduce the uptake of water by a young tea bush by 82.5 per cent. and it seems probable that the presence of unpruned branches, together with the more rapid production of new growth reduces the extent to which the roots are inactivated by pruning.

This does not appear to throw doubt upon the suggested causation of dieback at low elevations by carbohydrate deficiency, since no symptoms of nitrogen deficiency were noticeable in the new growth of the clean pruned bushes. It would be expected that a deficiency sufficiently severe to result in death of the frame branches would also affect the new growth.

An examination of the total nitrogen in tea roots from different elevations was made on aliquots of certain of the samples used for carbohydrate analysis. The regression of nitrogen on elevation, based on thirty samples (Figure II) is

$$Y = 1.065 - 0.002X.$$

The coefficient of X is insignificant and thus there is no evidence that nitrogen content of the roots varies with the altitude. The total nitrogen content of the roots thus provides no explanation of the altitudinal distribution of dieback.

Pruning Experiments:—The yield of the plots at Talawakelle, Peradeniya and Kiriella has been recorded over a period of two years from pruning. The results are given as total yields in the first and second years, thus eliminating differences between the data due to seasonal variations in climate but not those due to differences in climate between the two years.

	First Year			Second Year		
	Lung	Clean.	Cut Across	Lung	Clean	Cut Across.
Talawakelle.	44.66	48.56	46.62	68.20	74.53	63.46
Peradeniya.	76.07	72.74	75.31	91.52	90.45	81.91
Kiriella.	56.92	48.01	63.40	117.90	107.76	120.15
Mean.	59.22	56.44	61.78	92.54	90.91	88.51

The values of Z for treatment at Talawakelle and Kiriella together with significant differences in pounds were:—

	Z		Z	
	First Year.		Second Year.	
Talawakelle	...	0.7704	...	0.8640
Peradeniya.	...	0.2513	...	0.4585
Kiriella.	...	1.9786	...	1.2847

Z for $P.05 = 0.7058$ and Z for $P.01 = 1.0114$

	Significant Difference	
	First Year	Second Year
Talawakelle	...	2.85
Kiriella	...	3.67

These values lead to the following conclusions, taking the yield of the clean pruned plots as the control.*

	First Year	Second Year
Talawakelle.	Cut across = Clean $\triangleright$ Lung.	Cut across $\triangleleft$ Clean $\triangleright$ Lung
Peradeniya.	Cut across = Clean = Lung.	Cut across = Clean = Lung
Kiriella.	Cut across $\triangleright$ Clean $\triangleleft$ Lung.	Cut across $\triangleright$ Clean $\triangleleft$ Lung

* $A \triangleright B$ denotes that A is significantly greater than B

$A = B$ denotes that A does not differ significantly from B

$A \triangleleft B$ denotes that A is significantly less than B .

The absolute differences between clean pruning and lung pruning vary little from year to year at the three stations and do not increase proportionately to the greater yields in the second year, a result which suggests that the effect of the presence of leaves on the bush during the recovery period diminishes with time from pruning. At Talawakelle lung pruning results in a diminution in yield, but at the lower elevations this effect disappears and the reverse occurs. At Peradeniya no difference is detectable between the effects of the two methods, while at Galatura lung pruning results in an increased yield.

The effects of cut across pruning, when compared to clean pruning, are not as simple. In the first year, the yields of the cut across plots do not differ significantly from those of the clean pruned plots at either Talawakelle or Peradeniya, while at Kiriella cut across pruning yielded more than clean pruning. In the second year, similar results are obtained, save that clean pruning yields more than cut across pruning at Talawakelle. The absolute differences in yield between the two treatments in the first and second year, while similar at Galatura, increase considerably at Talawakelle and Peradeniya.

The dissimilarity between the fall of the yields of the cut across plots relative to those of the clean pruned plots with time at Talawakelle and Peradeniya and at Kiriella is possibly due to the effect of dieback in reducing the differences between the cut across pruning and clean pruning—an effect which has already been noted in connection with the number of primary shoots produced after pruning.

Although in general the yield in the second year is greater than in the first, partly owing to the larger number of harvests, the increase is not similar in different districts. The greatest difference is at Kiriella, where the yield in the second year is more than twice as great as in the first. The yields in this district have undoubtedly been influenced by the amount of dieback and the number of deaths that occurred after pruning, the relatively small yield in the first year being probably due to the loss of frame branches and the small number of primary shoots that are produced.

Length of Plucking Round:—An experiment to determine the effect of plucking tea on a seven-day round, as opposed to a fourteen-day round, was performed during 1933-34. In addition to recording the yields obtained under the two treatments, the leaf from the seven-day plots was manufactured together with that from the fourteen-day plots, wherever the pluckings coincided, *i.e.*, every fourteen days.

The yield per acre (reckoning 3,000 bushes to the acre) obtained on the plots plucked every seven days during a period of forty-eight weeks was 529·35 pounds. The plots plucked every fourteen days yielded only 420·72

pounds per acre during the same period, a reduction of 108·63 pounds per acre compared to the seven-day plots. This difference is very highly significant, and leads to the conclusion that a long plucking round leads to a substantial reduction in crop.

It was possible that this might be offset by an improved market value of the made tea. The results of experimental manufacture do not, however, show any sign of such a tendency. The mean difference in market valuation of the teas made on twenty-one separate occasions, as appraised by three tea tasters, was only 0·07 cents per pound in favour of fortnightly plucking. This difference is entirely insignificant.

The teas were marked for colour, strength, pungency, quality and flavour. Differences in favour of fortnightly plucking of 0·10 of a mark for colour, 0·24 of a mark for quality and 0·29 of a mark for flavour were found. These results are entirely insignificant. Differences, also insignificant, in favour of weekly plucking of 0·14 of a mark for strength, and 0·15 of a mark for pungency, also occurred.

The marking varied from occasion to occasion, sometimes favouring one treatment and sometimes another. The small differences observed, therefore, cannot be interpreted as indicating any *real* differences between the treatments whatever.

The experiment has thus led to the conclusion that a long plucking round, while reducing yield, does not affect the market value of the teas. It is, therefore, a suitable method of reducing crop during restriction.

A standard flush of two leaves and a bud was insisted on, plucking to a full leaf. It was found that on the fortnightly plots the flush that was not sufficiently developed to be plucked on one occasion grew to a larger size during the period prior to the next plucking than did the corresponding flush on the seven-day plots. The difference in size was mainly due to a greater development in size of the first and second leaves below the bud. On the whole, therefore, the size of a plucked shoot from the fortnightly plots was greater than that of a plucked shoot from the weekly plots.

The exigencies of experimental layout do not permit of costing, and it is therefore undetermined whether the enhanced yield obtained by shorter plucking rounds actually compensated for the greater cost of more frequent plucking. This point requires examination under estate conditions.

F. R. TUBBS,

Plant Physiologist.

REPORT OF THE AGRICULTURAL CHEMIST FOR 1934.

Acting Charge:—The Agricultural Chemist remained in charge of the Biochemical Department until February 28th, when he handed over the division to the Director. From August 22nd to October 7th he acted as Director. From November 1st he assumed charge of the field work in connection with the Physiological Department.

Advisory:—Correspondence.—The Department received 252 letters and despatched 235, thus showing an increase over previous years. As heretofore, the main theme of the enquiries was the efficient use of artificial manures. The Institute's experiments, though still in their infancy, have already supplied data for advisory purposes, and their expansion is only delayed by lack of suitable areas of mature tea. In the near future further areas will be released to cope with much-needed expansion.

Estate Visits:—During the year 27 visits were made to an equal number of estates for advisory purposes. In addition, the Agricultural Chemist paid 5 visits to the Passara Sub-Station, and the Field Assistant a further two to the same estate.

Lectures, etc.:—Addresses were given before three District Planters' Associations, and to the Central Board of Agriculture. The substance of these has been published in *The Tea Quarterly*. The following are the details of subject and place:

The Cultivation of Shade Trees, Green Manures and Cover Crops — Deniyaya P. A.

A Review of the First Pruning Cycle of the Tea Research Institute's Manurial Trials. — Dolosbage-Kotmale P. A.

Some General Problems of Manuring — Dickoya P.A.

The Indore Compost Process in Relation to Tea Estates — Central Board of Agriculture, Peradeniya.

Acknowledgments:—The Department is much indebted to the Superintendent and owners of Gonakelle Estate, Passara, for the facilities and co-operation afforded in carrying out field experiments at the Passara Sub-Station.

ORGANIC COMPOSTS.

The continual emphasis placed by agriculturists on the conservation of humus in soil has for years played a great part in the development of green manuring in tea culture. The depression, which brought with it a diminution, and, in some cases, a cessation of manuring, has served to emphasise the problem still further. During the year under review much attention has been paid to the utilization of waste vegetable and animal products for the production of bulk organic manures of the compost type.

There are two processes that have elsewhere been carried to a successful practical issue, the Indore process and the Adco process. Though they differ in method they are similar in extent.

The Indore Process:—The object of this process is to combine in a humified form the valuable nutrient elements present in waste vegetable matter and the waste products of animal excreta. As originally worked out, harvest refuse, weeds, dung and urine absorbed by earth, are all employed, giving on fermentation in pits a well-rotted, homogeneous manure dry enough to handle easily, and containing on the average about one per cent. of nitrogen. This nitrogen whilst being available to the plant, is not readily lost by drainage and seepage, on account of the relatively high carbon nitrogen ratio of the finished material. Under certain specified conditions of manufacture it can be produced very cheaply and proves a great asset to agricultural enterprise.

Its adoption on tea estates raises a number of fundamental questions.

- (1) Are the waste products in tea cultivation available in sufficient bulk to enable manufacture to be carried out with low overhead charges ?
- (2) Are estate conditions generally such that, assuming sufficient material, the cost of handling is not prohibitive ?
- (3) If special material has to be grown, cut or carted, will this necessity unduly enhance the cost?
- (4) If existing green manures are distrained upon, will the increased benefit of composting, compared to forking-in direct, more than cover the extra cost of handling ?
- (5) Is any presumptive benefit from composting as great in the cultivation of a perennial crop with a continuous growing season, as in the cultivation of an annually sown crop with a strictly limited period of nutrient absorption ?

The practical issue resolves itself into one of cost. The topography of Ceylon tea estates offers distinct difficulties in the handling of materials such as prunings, and in their transport to the manufactory. Other waste material is strictly limited. The optimum quantity for production is laid down by Sir Albert Howard as 1,000 tons per annum, but in the light of local conditions, there does not seem to be even a fleeting possibility of producing so much on the average-sized estate.

In order to obtain information on the cost of the process under Ceylon conditions, arrangements have been made to co-operate with Messrs. James Finlay & Co., Ltd. in the production of 100 tons of compost. Whilst every effort is being made to minimise the costs, every item of material and labour is being carefully assessed and accounted for. At a later date the agricultural use of the finished material will come under review.

The Adco Process:—The Adco process deals with waste vegetable material only, and the nitrogen and other substances required to bring about a suitable fermentation are added in an artificial form instead of as animal excrements. During the year a number of samples of Adco manure have been drawn from a number of estates, and their composition determined. The special interest of these samples is that they were all made from weeds. With one exception all heaps were of sufficient age to have completed their useful fermentation period; some had been in existence for a longer period than is normally reckoned necessary.

The results of the analyses bring out several points of interest. The heap still in process of manufacture (a) is the only one with a moisture content above 70 per cent. which is approximately the normal for compost of this type. The season was a very dry one, and although adequate precautions were taken to protect heaps from excessive evaporation, and to water them regularly, the difficulties were plainly shown by the moisture figures.

TABLE I.

Sample	Moisture %	Nitrogen % on dry Matter	% Loss on solution	Loss on solution % of loss on Ignition	Residue %
(a)*	71·8	1·69	40·5	66·6	39·2
(b)	58·6	1·35	26·5	57·8	54·2
(c)	56·0	1·09	18·6	48·5	61·6
(d)	49·1	1·20	22·3	57·7	62·4
(e)	51·4	0·89	25·1	61·7	62·3
(f)	40·9	1·44	27·8	57·5	51·7
(g)	40·8	1·30	24·2	54·5	55·6

*Two months old and still in process of manufacture.

The nitrogen contents of the samples are low in every case except that of material still in the manufacturing stage. This is probably due to the period of manufacture being extended beyond the optimum time. In previous work on the subject, published in the report of this Department for 1930, it was shown that three months was an adequate time for manufacture, and this has been confirmed by later work on St. Coombs. A nitrogen figure of two per cent. or more should be obtained from finished Adco, if the original material and manufacturing processes are suitable.

The third column of Table I gives the percentage of the sample which had definitely humified. This fraction was assessed by oxidising the material with dilute hydrogen peroxide, and determining the loss on solution. Again the figures are all low. These low figures might be due to two causes: (a)

the rotting of vegetable matter might be incomplete, or (b) the heaps might contain a large quantity of material of a non-vegetative character. Columns four and five bear on these points.

The loss on solution expressed as a percentage of the loss on ignition gives a working figure for the amount of humifiable material that has actually rotted. Bearing in mind that certain constituents of plant leaves and stalks do not readily rot down because they contain considerable amounts of highly resistant lignin, the results in column four indicate that a moderate efficiency was reached. The weeds from which the adco was prepared contained a predominance of maiden-hair fern derived from mossing and ferning operations following pruning. The stalky portions of these are very resistant, and are not suitable material when used in bulk. The same applies to the underground rootstocks and stems of perennial grasses.

The last column shows the residue when all vegetable matter has been removed: it consists of earth and nothing else. The fact that in all cases a great deal of earth was incorporated in the heap affords an explanation of the low quality of the product. When, as in most of these samples, over half the material is soil, not only is the quality of the adco diminished, but a great deal of expense is incurred in moving inert and valueless matter to and from the manufactory.

From these samples the following points emerge. If weeds provide the basis of manufacture, they should be used after sufficient drying to remove adherent earth; the heap can always be watered to give the correct degree of moisture. A preponderance of fern is unsuitable for use in adco heaps because of the lignified nature of the stem tissue. In nearly every case a mixture with more bulky material, such as green manure loppings, would help to keep the heap well-aerated and would improve the finished product.

MECHANICAL COMPOSITION OF SOIL.

For some time after the establishment of this Department of the Institute, considerable difficulty was experienced in determining the mechanical analysis of Ceylon tea soils. These difficulties were of a varied nature. The standard method formerly involved the use of six per cent. hydrogen peroxide, which at that time was unobtainable in Ceylon in any quantity. Furthermore, the presence of manganese in soils greatly reduced the efficiency of the peroxide in oxidising the organic matter. At a later date work on mechanical analyses had to be discontinued because there was no method available for shaking the soil water suspensions for the requisite period of 24 consecutive hours.

All these difficulties were cleared by the Imperial Bureau of Soil Science in one of their technical communications. Special mention of this is desirable as the value of the Imperial Bureaux is not generally recognised in Ceylon,

and there is an entirely mistaken notion that workers in applied science are independent of the results and labours of those working elsewhere on fundamental problems. The importance of co-operation between one tea research institute and another is granted, but it is not so plain to the general public why a tea research institute in Ceylon should have a great interest in the research of a university professor in Wales who is a stranger to the tea plant.

The results so far obtained have two interesting features. They show that typical tea soils are heavy and contain large quantities of the clay fraction. What is particularly noticeable is that there is in many cases, very little difference between the top soil within the range of cultivation, and sub-soil below it. In the following table the two sand fraction (coarse and fine) are amalgamated, and the quantities for sand, silt and clay calculated as percentages of the total value for these classes.

TABLE II.
Percentage Composition of Top and Sub-Soils.

Soil	Sand		Silt		Clay	
	Top	Sub	Top	Sub	Top	Sub
1T 2S	39	34	9	7	52	55
5T 6S	64	52	9	8	27	40
7T 8S	64	64	30	30	6	6
13T 14S	35	34	12	18	53	48
15T 16S	59	61	10	11	31	28
23T 24S	68	62	6	10	26	28
26T 27S	50	48	10	21	40	31
58T 59S	46	40	9	9	45	51
64T 65S	64	53	6	7	30	40

The general agreement between top and sub-soil fractions together with the general low level of the medium silt fraction suggests that we have lost the usual top soil by erosion, leaving behind an undifferentiated sub-soil very difficult to cultivate adequately. This interpretation is also borne out by preliminary studies in soil penetrability. Most soils tried so far show a reasonably constant relation between the distance of penetration of a steel stylus, and the force required to bring about that penetration, *i.e.*, they are homogeneous. Where top and sub-soils are easily distinguishable by colour or textural changes, the impact penetration curve exhibits well-defined points of inflexion where top and sub-soil meet.

MANURIAL EXPERIMENTS.

The end of the first pruning cycle of the potash and nitrogen manurial experiments was mentioned in last year's Report, where the third year

results were given. Further results from the whole period of the experiment are now available.

The yields of flush over the whole cycle are set out in Table III.

TABLE III.
Yields per acre in lb. dry matter from 3-year Pruning Cycle.

	Potash			Nitrogen			Type of Nitrogen		
	Nil	20 lb.	40 lb.	Nil	20 lb.	40 lb.	Blood	Cyan- amide	Sulphate of Ammonia
		p.a.	p.a.		p.a.	p.a.			
Gross Yield	2142	2094	2148	1962	2130	2294	2214	2173	2249
Percentage of mean	101	99	101	92	100	108	100	98	102

Only differences between figures in heavy type can be relied upon as being due to manurial applications; they are well outside the limits of error. The notable points are that potash has produced no yield increment; that nitrogen has increased yield in proportion to the dose used; and that the three types of nitrogen have behaved alike. The results from the differing quantities of nitrogen are specially interesting. The fact that the 20 lb. dose of nitrogen has produced an 8 per cent. increase in yield, and that the 40 lb. dose has produced an increment exactly double, demonstrates that the law of diminishing returns, has not been operative over the range of quantities used.

At the end of the pruning cycle, a series of samples of prunings were collected from the experimental areas. Twenty-five bushes from each plot were taken, so that for each level of nitrogen or potash manuring an aggregate sample of 450 bushes was available. These samples were dried, the foliage leaf and wood separated by hand picking, and weighed separately for each plot. The yields are given below.

TABLE IV.
Yields per acre of Leaf and Wood removed in Pruning

	lb. N. applied per acre			lb. Potash applied per acre		
	0	20	40	0	20	40
Foliage leaf	1547	1560	1761	1549	1668	1651
Wood	2052	2177	2514	2161	2284	2298

As is natural when the type of material is considered, the errors pertaining to these yields are higher than are encountered with flush. When compared with the calculated errors, the results show that the increase in both leaf and wood is indubitable when 40 lb. per acre of nitrogen are used. Potash on the other hand has shown no consistent effect. In the main, the frame

of the bush has responded to manurial applications in the same fashion as the flush. These results offer no support to the frequently stated theory that it is possible to manure for wood or flush production independently.

UTILIZATION AND RECOVERY OF NUTRIENTS.

The yields of the produce from field experiments, in conjunction with a knowledge of the composition of the materials that are weighed, give interesting information on the utilization and recovery of nutrients from the soil and from the added source of manure. The earliest agricultural experiment on record which was started just over a hundred years ago, showed how informative a balance sheet of nutrients supplied and used could be. In the case of tea a complete balance sheet is difficult to draw up because, with a perennial crop, a complete excavation of bushes, including the roots, interferes with the continuity of the experiment. For this reason it is necessary to deal in our case with new growth only, as represented by flush and prunings. In any case this represents the bulk of the growth made during a pruning cycle.

Table V. gives the quantities of nitrogen found in a crop of 2,100 lb. per acre in three years. A general inspection of the figures shows that of the total quantity of nitrogen removed in flush, foliage and wood the largest amount is found in the flush and comprises nearly two-thirds of the whole. The total quantity of nitrogen used is considerable even in the case of tea receiving none as manure. In fact one of the striking features of the data is how relatively small is the contribution made by added manure. The addition of 120 lb. of nitrogen as manure has increased the nitrogen yield of the crop by less than 22 lb.; so, the recovery during the pruning cycle amounts to no more than 18 per cent. This low figure is produced despite the fact that in a previous section it has been shown that the manure was being advantageously used by the plant over the whole range of quantities supplied. Compared with recoveries by annual crops in temperate climates the utilization is poor; most of the published figures for such crops showing double or treble the recovery achieved in this experiment.

TABLE V.
Removal of Nitrogen by a 2,000 lb. crop (in lb. per acre).

	Plots receiving nitrogen per acre (in 3 years).		
	Nil	60 lb.	120 lb.
Flush	80·2	87·1	93·8
Foliage	31·2	31·5	35·5
Wood	17·4	18·4	21·3
Total	128·8	137·0	150·6

Total recovery $21·8 = 18$ per cent.

In a similar fashion figures for total removal of potash and phosphate can be calculated, but because potash showed no response in yield, and because no increments of phosphate were included in the experiment, no distinction can be drawn between what is derived from soil and manurial resources respectively.

TABLE VI.

Removal of Nutrients by a 2,100 lb. Crop (in lb. per acre).

	Nitrogen	Potash	Phosphoric acid
(1). Flush	87	35	18
(2). Wood.	19	12	4
(3). Foliage.	33	17	6
Total	139	64	28
Permanently removed (1) & (2)	106	47	22
Quantity removed per annum.	35	16	7

The nitrogen figures are simply the mean of those already given, and are included here for the sake of comparison with the other nutrients. The potash figure shows that although in yield per acre the potash gives no yield response, yet a considerable drain is made on the soil resources each year. Viewing manuring as an attempt not only to produce crop, but to conserve soil fertility, the data indicate that until more is known about the reserves in the soil, it is advisable to use potash in manure mixtures, and not to assume that soil potash is illimitable in extent. The phosphoric acid demands are small, but it is known that to recover this amount per annum something like six times the amount must be used. This would seem to point to moderate doses of phosphoric acid as advisable, but gives no evidence that the high doses sometimes used are necessary.

THE COMPOSITION OF THE MADE TEAS.

Since it fell to this Department to complete the work which Dr Evans had planned, and to a large extent carried out prior to his resignation, the results obtained will be reported here instead of in the Biochemical report.

In Table VII a comparison in mean composition is made between teas receiving no nitrogen and those receiving 40 lbs. per acre per annum. These analyses are based on the samples manufactured on the experimental machinery. With the exception of total oxidisable matter (which has been found to be a satisfactory reflection of tannin content for comparative purposes) the figures are percentages on the dry tea. The T. O. M. figure is simply an index figure.

TABLE VII.

Comparison of Tea Receiving no Nitrogen and 40 lbs. per acre Respectively.

	(1) No Nitrogen	(2) With Nitrogen	Difference (1) - (2)
Extract	41·44	41·46	- 0·02
Nitrogen in Extract	1·61	1·67	- 0·06
T.O.M.	233·90	232·10	+ 1·80
Caffeine	3·14	3·25	- 0·11
Ash	5·25	5·16	+ 0·09

It is evident that manurial treatment has made very little difference to the composition of the teas. Only those differences in heavy type are consistent enough to be safely regarded as due to the difference in treatment, when interpreted in conjunction with the known experimental errors. Even these cannot be regarded as of practical importance.

Table VIII shows similar figures for the three types of nitrogen. In these comparisons none of the differences are large enough to be regarded as due to other than chance causes.

TABLE VIII.

Comparison Between Different Kinds of Manurial Nitrogen.

	Sulphate of Ammonia	Cyanamide	Bloodmeal
Extract	44·24	44·12	44·26
Nitrogen in Extract	1·69	1·63	1·62
T.O.M.	259·3	263·4	262·4
Caffeine	3·28	3·28	3·25
Ash	5·33	5·28	5·26

Since the completion of the first pruning cycle, the results of which have been summarised above, the scope of the experiment has been widened. Doses of phosphoric acid have been varied in the quantities nil, 30 and 60 lb. per acre, so that in all there are 27 different manurial treatments in the experiment instead of nine as heretofore. In addition, since cyanamide is now of only academic interest as a manure for tea, this treatment has been changed to groundnut cake which remains steadily in use. Whilst the question of quality of made tea in relation to increase in nitrogenous manuring and to organic and inorganic manuring is still being watched,

the effects of potash and phosphoric acid are included in the programme of the present cycle. This will give in time a very comprehensive survey of the functions of the three main nutrients in the nutrition of tea.

During the year under review, the subsidiary experiment at Passara on the three factors (1) time of application (2) organic and inorganic and (3) quantity of phosphate, has completed a full year. As explained in the previous report this experiment has not been weighed for yield at each plucking, but only every third round. Owing to the period that elapsed between pruning and tipping only ten recorded rounds are available. The errors are consequently at present higher than in a complete experiment such as is carried out at St. Coombs, but there is every reason to believe that they will diminish as more results are obtained.

Because total yields are not taken, data cannot be given in lb per acre, and the yields are, therefore, given on a percentage basis. They are tabulated in Table IX.

TABLE IX.

Relative Yields of Tea at Passara.

	Treatment	Percentage Yield	Significant difference
Time of application	2 months before pruning	102	12·5 per cent.
	at pruning	98	
	2 months after pruning	100	
	Organic manures	97	10·2 per cent.
	Inorganic manures	103	
	30 lbs. p.a. phosphoric acid	100·5	10·2 per cent.
	60 lbs. p.a. phosphoric acid	99·5	

None of the differences is significant in relation to the known error, and we can safely assume that there has been no practical effect due to time of application and quantity of phosphatic manuring. The difference between organic and inorganic treatments is well within the limits of error at present, and its subsequent behaviour will be a matter of particular interest. This experiment whilst not being of exactly the same design as that at St. Coombs, is auxiliary to it in its exploration of phosphatic differences and types of nitrogen.

A further experiment also designed to supplement the St. Coombs work has been laid out at Passara, but yields so far are insufficient to report.

The experiment bears on the effect of all three nutrients nitrogen, potash and phosphate, and includes the following treatments :—

- (1). Nil.
- (2). Nitrogen 40 lb. per acre.
- (3). Potash 40 lb. per acre.
- (4). Phosphoric acid 30 lb. per acre.
- (5). Nitrogen and Potash.
- (6). Nitrogen and Phosphoric acid.
- (7). Phosphoric acid and Potash.
- (8). Nitrogen, Potash and Phosphoric acid.

In this way the behaviour of manures in both the single and double monsoon areas is now under review for all nutrients in common use.

COVER CROPS.

The climatic conditions of 1934 militated against the establishment of cover crops. During the heavy monsoon of 1933 a garden crop of subterranean clover (*Trifolium subterraneum*) grew quite well, and a more extensive trial was made in 1934. One of the disadvantages of subterranean clover is that it is not a perennial, but varieties exist which produce seeds of varying hardness. These will germinate over a more or less long period, thus giving a continual renewal of seedlings to replace plants that have died down.

Through the kindness of the Waite Agricultural Research Station, Adelaide, samples of one of these varieties 'Dwalganup' were obtained. In addition, ordinary commercial seed was sown. From the same source we received several perennial clovers which have been successful in Rhodesia and Kenya at an altitude of 5,000 feet.

The full trial consisted of :—

Annuals.

- Trifolium subterranean* (Mt. Barker, commercial)
 „ „ (Dwalganup early)

Perennials.

- Trifolium repens* (New Zealand certified).
 „ *fragiferum* (No. 2078 Palestine strawberry clover).
 „ „ (No. 1126 Commercial strawberry clover).

None of these varieties survived the rigours of the climate although several sowings were made. If further seeds are obtainable they will be tried again.

T. EDEN,
Agricultural Chemist.

REPORT OF THE TEA TECHNOLOGIST FOR 1934

Staff:—The Tea Technologist commenced duties on the 12th February 1934, and spent the earlier part of the year in becoming acquainted with conditions of manufacture in Ceylon.

The Assistant Staff remained unchanged.

Correspondence:—402 letters were received and 386 despatched. These related mainly to factory problems, but included a number of reports and analyses for Colombo Agency Firms. These analyses have been chiefly concerned with tannin and caffeine contents.

Medical advisers still appear to attach considerable importance to tannin contents with little appreciation of the pharmacological action of tea tannin. Tea tannin is often loosely associated in the lay mind with tannic acid which gives a very wrong conception of its properties.

In one case the estimation of chlorophyll was undertaken.

Firing does not appear to destroy chlorophyll to any large extent. Chlorophyll constitutes about 1 per cent. of made tea and does not vary much from this figure in different teas.

Advisory:—The advisory work of the Department has taken up a considerable amount of the time of the staff. Twenty factories were visited, several of these visits being made to estates where complaints had been received of deterioration of their teas in transit.

It is a highly significant fact that not one of these estates was equipped with apparatus for determining the moisture content of the teas despatched.

Low exhaust temperatures were found in several cases, this fault being usually due to overloading. Every firing machine should be equipped with an exhaust thermometer placed in such a position that the person responsible for the thickness of spreading can see the scale without difficulty. The exhaust temperature should not fall below 120°F. If this temperature is not attained then the thickness of spreading should be adjusted. Leakages of cold air into suction driers may also give rise to troubles of this nature. If out-turn is low the fan speed may need raising. It must be realised that dhool fed into a firing machine is constantly varying in moisture content, and a firing machine can only be set to evaporate a certain amount of water per hour, and not to turn out a fixed rate of made tea.

Low exhaust temperatures most probably have a very intimate connection with the deterioration of made tea. One of the objects of firing is to inhibit fermentation, and there are two factors controlling this inhibition, one dryness, and the other temperature.

At low temperatures it is doubtful if sufficient of the ferments are actually destroyed by the heat of firing. So long as the moisture content remain below, say, 4 per cent., the remaining ferments cannot do much damage, but if the moisture content rises during transit, or, if the tea has not been fired to a low enough moisture content, then teas fired at a low exhaust temperature, may be expected to deteriorate rapidly. A certain amount of laboratory work has been done on this question of the amount of enzyme activity after firing. The major difficulty lies in the measurement of the amount of enzyme activity in the presence of tannin.

Recent advances in physical chemistry may help us in this work, and to this end preliminary enquiries on the subject of oxidation-reduction potentials have been set afoot.

Samples.—902 batches of samples were received during the year, mainly for determination of moisture contents.

Although many estates have installed apparatus for determining moisture content, many seeking advice from this Institute at the time of purchase, there is unfortunately a section of the industry still working in the dark with regard to their firing.

The samples received by the Institute serve to show how widely firing may vary, and in particular how ineffective so much final firing is.

Cases have reached our notice where moisture content is actually higher after, than before, final firing. What happens is that the tea is merely warmed up during the so-called final firing process and on cooling takes up more moisture.

The Institute is willing to give all the help it can in checking up drying data. The working of a number of firing machines has been examined for various estates by determining moisture content of leaf removed from both sides of each tray of the machine. A graph is then plotted for each side and the mean and this often reveals uneven firing or faulty rates of drying.

In future the rate of evaporation in terms of pounds of water from 100 lbs. leaf for each tray, will also be plotted as it may reveal undesirable conditions, whereas the ordinary moisture content curve does not show them up in such a marked manner.

Some of the samples received by the Institute are packed in a manner liable to lead to unsatisfactory result. Ordinary lead packets and sample tins unless very well made are very far from air-tight, with the result that small samples may take up, or lose, considerable quantities of moisture, particularly if delayed in the post, or over a week-end in extreme climatic conditions.

The safest way of packing is in a cigarette tin with Dunlop $\frac{5}{8}$ in. insulating tape folded over the rim and the lid forced down over the tape. The tape in this case seals all space between the lid and the tin. If there is a patent cutter fitted in the lid, this should be forced back so that the knife does not come between the lid and tin, otherwise it forms a gap between the lid and the top of the tin. The cutter should also have a piece of tape sealed over it on both sides of the lid. A specimen will be sent to anyone wishing to copy.

Comparative tests were made between the three methods of packing samples and the results obtained are shown in the following table. In the case of circular sample tins and lead packets care has to be taken to choose the best available.

Even under these conditions the cigarette tins sealed with insulating tape showed a marked superiority over the others on an all round performance.

Despatch of Teas to England.—The moisture contents of several invoices between the estate and London were followed up. On the average about 3 per cent. of moisture was gained on the journey.

This has led us to advise 4 per cent., as a safe moisture content for packing tea.

Tea rapidly gains moisture in Colombo, which means that tea should pass through the agents' hands as quickly as possible.

So far we have not obtained any information on the gain between the estates and London during the various seasons. This point, together with the effect of the type of packing, will be investigated. For this purpose the co-operation of companies handling teas in various parts of the world will be needed to obtain definite information.

It may be that various markets require different packing, and firing to lower moisture contents than usual in order that Ceylon teas may retain their best properties.

No definite information is as yet available as to the best moisture content for maturing processes to carry on.

Tasting of Experimental Samples:—Since the result of much experimental work is eventually a matter of tasters' opinion, it is obvious that we should try to get the tasting of our experimental teas done in as efficacious a manner as possible.

Our difficulties were put before the Colombo Tea Traders' Association and a Conference was held at which this matter was discussed.

As a result of this meeting there was a very generous response to our appeal for help, and our experimental teas are now submitted to a meeting of tasters who evaluate and discuss the teas put before them. At the same time the samples are sent to five large buying concerns whose tasters also give their opinions.

Our thanks in this connection are due firstly to Mr. R. H. Horne, who has made many helpful suggestions and made arrangements for the meeting of tasters, and to the following firms:—

Messrs. Forbes & Walker,
 „ James Finlay & Co., Ltd.,
 „ Lee, Hedges & Co., Ltd.,
 „ E. John & Co.,
 „ Whittall & Co.,
 „ The Colombo Commercial Co., Ltd.,
 „ Brooke Bond Ceylon Limited.
 „ Lipton Ltd.,
 „ Carson & Co., Ltd.,
 „ Mackwoods Ltd.,
 „ Harrisons & Crosfield, Ltd.,
 „ Leechman & Co.,
 „ Heath & Co.,
 „ Darley, Butler & Co., Ltd.,
 „ Bartleet & Co.

Preliminary arrangements are being made for a similar system of tasting to be carried out in London. In connection with the investigation of deterioration chests or half chest samples will be sent. The system of sending large samples such as the latter may be extended to other experiments.

Tasters' Terms:—With the object of standardising tasters' terms, the Conference with Tea Traders' Association also discussed this matter with the result that a glossary of terms was prepared, and published in *The Tea Quarterly*, 1934, Vol. VII. p. 129,

Co-operation with Other Research Institutes:—In view of the projected programme of sulphur dusting against *Oidium* of rubber, the Rubber Research Institute asked us to examine the possibilities of sulphur tainting of teas.

The first experiment was carried out at Gonakelle, Passara, with the kind help of Mr. G. Kent Deaker, and in this 10 lbs. of sulphur dust was applied per acre. This was considered to be the limiting quantity and much more than would normally fall upon tea. As this quantity may, however, be used against red mite of tea this first experiment answered two questions.

It was found that 10 lbs. per acre applied within two or three days of plucking caused a very definite taint.

On analysis of the tea untreated leaf was found to contain 0.276 per cent. sulphur in the dry matter of the made tea, while in a plot dusted twice running immediately before plucking the sulphur content of the made tea rose first to 0.462 and then to 0.512 per cent.

In another plot dusted immediately after plucking, tea from the subsequent plucking contained 0.345 per cent. only.

There were no indications of sulphur being absorbed or accumulated by the bush.

The experiment is now being repeated, using 2 and 5 lbs. sulphur per acre, with the idea of determining the minimum amount of sulphur likely to cause tainting of made tea.

It is hoped that information will also be gained in regard to the length of time required for sulphur to disperse, and the bush become fit for plucking.

We were in touch with the Tocklai Research Station in connection with the sterilisation of factory plant by the use of a blow pipe flare. It hardly seems likely, however, that such drastic methods will be required in the average Ceylon factory.

The Java Research Station was supplied with details of some analytical methods.

FACTORY RESEARCH.

Withering:—The control and measurement of the process of withering is one of the outstanding problems of present day manufacture. Several methods of measuring wither have been tried or enquired into, the root of the whole difficulty being the sampling error.

How can an average sample of withered leaf be taken? While variations exist within each loft this is a particularly difficult problem to tackle, and only by taking several samples from each loft can the true state of affairs be judged. Multiplication of the number of samples, however, involves difficulties in obtaining rapid results.

This unfortunately is not the only difficulty encountered. With any method involving the measurement of loss of weight of the leaf the amount of free water, i.e., surface moisture in wet leaf, has to be contended with.

The best way of overcoming this difficulty appears to be, to start measurements only when all surface moisture has disappeared.

Provided the evaporation of surface moisture is uniform and the commencement of the measurement is not delayed when the first stage is completed, a fair approximation may be made. At any rate this is more accurate than making arbitrary allowances for surface moisture such as is often done.

Another complication is the gain in weight of the hessian comprising the test tats when wet leaf is being withered. This may be overcome by using wire mesh instead of hessian, but the open construction of wire mesh raises the question as to whether the test tats give comparable results with the normal ones.

At the present moment it seems that methods involving the measurement of moisture remaining in the withered leaf offer most hope of success.

Withering gauges involving the expression of the leaf moisture by pressure (oil pressure) have been experimented with. Several difficulties have been encountered which may yet be overcome. The method, however, is relatively slow when a large number of samples has to be dealt with.

A new method which has been devised and tried out in this laboratory appears to offer some hope of a rapid and effective means of estimating withers, but has yet to be adapted to factory conditions.

The samples of leaf are minced in an ordinary mincing machine which operation only takes a few seconds, and once the mincer is wet there is practically no loss. The weighed sample is then put into an oven which is, to all intents and purposes, a miniature drying machine, and dried with a rapid current of air at 220 to 230°F. This operation is complete

in 15 minutes. The samples are then weighed again. An ordinary moisture balance with an improvised rider may be used for this purpose, but it is hoped that a simple spring balance, like a parcel or letter balance, calibrated in percentage wither may be devised.

The advantage in this method lies in the number of samples which can be dealt with at one time.

A small oven made out of an ordinary tin can has given very satisfactory results.

There does not appear to be any reason why an apparatus of this nature should not be put on the market at a quite low cost. The blowing and heating equipment would be the most expensive parts. In the laboratory we used an old vacuum cleaner and elements from a disused heater for the purpose. If the oven could be by-passed from a factory dryer it would reduce its cost materially.

Another interesting development occurred during the year when the Cambridge Scientific Instrument Company put a moisture tester on the market, the method being an electrical one.

Unfortunately good results are not obtained with withered leaf owing to it being a conductor of electricity. With made tea quite good results are obtained.

Several different kinds of hessian and withering material have been tried out. Amongst these are Greenisle wither linen, a cloth made by the Ceylon Spinning and Weaving Co., Ltd., and a fire-proofed hessian. A fire-proofing solution for hessian has also been tested.

The major difficulty with the fire-proofing agents was found to be their solubility in water.

Apart from the risk of tainting, which in dry weather has not proved to be serious, there is the probability of the gradual removal of the fire-proofing compounds by leaf which is wet when spread on the tats.

Analysis has revealed the presence of ammonium chloride and ammonium phosphate as the major constituents of one of these fire-proofing medicines.

The practical failure of the monsoons has necessitated the prolongation of these trials in order that behaviour under damp conditions may be examined.

Arrangements had been made for experiments on withering at different temperatures and humidities. Unfortunately the air conditioning

plant which was to be placed at our disposal for these experiments proved, on arrival in Ceylon, to be quite unsuitable for the purpose.

The experiments carried out on these lines by Hall and Dickson and reported in *The Tea Quarterly* indicated the prospect of some promising results.

Colour in Teas.—Previous experiments carried out at this Institute have indicated that while long withers may lead to a loss of quality and flavour and perhaps pungency, they give liquors of better colour and strength than shorter withers.

An attempt was made to utilise this to improve the colour of teas made with a shorter wither.

Tea made with a long wither of 60 hours was blended in various proportions with tea made from a wither of 18 hours, which usually resulted in a light “pointy” liquor.

When sent for report one of the blends was preferred to either of the pure long or short withered teas, in every case. With one exception the tasters chose either:—

- (a) 3 parts long wither with 10 parts short or
- (b) 1 part long wither with 10 parts short.

Rolling:—A few preliminary tests in connection with the proposed investigation of the rolling process have been carried out. An account of the scope of this investigation was given in the last Annual Report.

A contract has been placed with the Colombo Electric Tramways & Lighting Co., Ltd. for the necessary alterations to the experimental rollers which will all be driven by individual geared motors. A kilowatt recorder giving a large size record of the power consumed by each motor will be fitted in each unit.

Fermentation:—During the cold weather difficulty was experienced with the fermentation of experimental teas manufactured during the night. In the small experimental rollers very little heat is developed during rolling and the onset of fermentation is delayed.

The taster reported marked improvement in experimental teas fermented in an atmosphere warmed to 65°F.

In the large rollers the heat developed in rolling appears to be sufficient to set up fermentation, and the heat generated by fermentation processes maintains the necessary temperature.

Firing:—Several firing tests on various estates have been carried out. The results of the test of Marshall’s Improved “Empire” Drier will shortly be published in *The Tea Quarterly*.

Some aspects of firing problems have been dealt with under the advisory section of this report.

Preliminary experiments have been carried out on final firing. There would appear to be some conflict of opinion as to the desirability or otherwise of final firing. Quite apart from the question of moisture content, some tasters seem to prefer final fired teas, though whether this preference leads to a sufficient improvement in price to meet the cost of final firing remains a moot point. On the whole the Institute has rather deprecated final firing unless necessitated by the moisture content of the tea.

It is very probable that conditions during the first (single) firing may be intimately connected with need for final firing. For instance destruction of ferments may be one factor. This is an important question. Unfortunately our present experimental firing equipment can only be regarded as a means to an end, namely the manufacture of small amounts of leaf from experimental field plots. The apparatus is not in the least suitable for accurate experiments on the various factors constituting the firing process. We need to investigate one factor at a time, keeping the others constant, and this can only be done with a very special machine. There is sufficient information in hand to enable us to design a machine which will very probably suit our purpose, and it is hoped that we shall be able to instal this if funds are available.

Experiments have been commenced on the relative costs of firing with different fuels such as oil, coal, and coke.

Influence of Age of Leaf on Quality of Tea:—Leaf at different ages from pruning, plucked at the same time, was brought to St. Coombs from another estate for manufacture under standardised conditions in order to attempt to bring out differences due solely to age from pruning.

It was intended to carry on the experiment over an extended period, but unfortunately it was not possible to obtain further supplies of leaf from the estate concerned.

As it is not possible at present to carry out this type of experiment with leaf from S. Coombs, it is hoped that similar material may be obtained elsewhere, and preliminary arrangements have already been made to this end. Leaf at four different ages from pruning was manufactured on the above occasion.

Analysis of Tea made from Leaf at different ages from Pruning.

(a) Leaf manufactured on St. Coombs (B.O.P.) :—

Age from Pruning	% Extract	Total Oxidisable Matter (Tannin equivalent).
37 weeks	44.5	228
81 weeks	45.3	253
146 weeks	46.1	268
198 weeks	44.8	259

(b) Leaf manufactured on Estate (a) B.O.P.

42 weeks	40.7	201
84 weeks	43.2	230
99 weeks	43.3	236
188 weeks	43.5	232

(b) B. P.

42 weeks	40.4	201
84 weeks	42.2	229
99 weeks	42.8	230
188 weeks	43.0	225

(c) B.O.P.F.

42 weeks	39.9	195
84 weeks	40.1	218
99 weeks	41.2	225
188 weeks	41.1	223

There are indications of a fall in tannin content after three years.

This fall in tannin content has not been followed out on St. Coombs tea since the pruning cycle has not been extended beyond three years.

The figures so far available for St. Coombs leaf are as follows :—

	Total Oxidisable matter.
6 months	149.6
1 year	223.0
18 months	224.9
2 years	231.6
2½ "	263.6
2¾ "	266.3

These figures are, however, purely tentative as seasonal factors have to be allowed for.

The analyses were carried out on samples obtained from the experimental manufacture of leaf from a pruning experiment.

In addition to the acknowledgments already made, thanks are due to many planters and engineers who have afforded assistance during the year, and particularly to Mr. F. J. Whitehead.

J. LAMB,
Tea Technologist.

ANNUAL REPORT OF THE SMALL-HOLDINGS OFFICER FOR 1934.

Meetings and Lectures:—Six meetings of small-holders were held during the period under review in Uda-Palata, Yati-Nuwara and Deniyaya in the Matara District.

At these meetings special mention was made as to the usefulness of cultivating green manures and cover crops on holdings, and the advantages resulting from the use of "Lock-and-Step" drains and "Rim-Lung" pruning.

The village minor headmen rendered valuable assistance in organizing these meetings in co-operation with small-holders who are keen on maintaining their holdings in a good state of cultivation.

The meeting at Deniyaya was arranged by the Chairman of the Morawak Korale Planters' Association, who was very keen that small-holders in this area should also adopt the new methods and improve their holdings. There were over 250 present at this meeting.

Demonstration Work:—The villages mentioned below have been visited every month or alternate month. Particular attention was paid to the villages in Uda-Palata where a competition has been organized among the small-holders by the District Agricultural Committee.

During the year 137 holdings were visited and demonstrations carried out both in pruning and draining.

At these demonstrations every endeavour is made to explain both to the owner and the worker the importance of adopting the new methods advocated and the benefits to be expected from more systematic work on the holdings.

Uda-Palata

Attabage-Udagama
 Attabage-Pallegama
 Angammana
 Bowella
 Doluwe
 Dunukeulle
 Hindagalla
 Harakolla
 Kalugommuwe
 Kirinde
 Lagundeniya
 Naranvita
 Ulapane

Udu-Nuwara

Aludeniya
 Ambanwella
 Bambradeniya
 Ganhatha
 Geli-Oya
 Gadaladeniya
 Hendeniya
 Imbuldeniya
 Kossine
 Lagamuwe
 Polgahange
 Talawatura

Uda-Palata	Udu-Nuwara.
Tembiligalla	Wegiriya
Thelihunna (P.P Settlements)	Welligalle
Lagundeniya „ „	Wellambodde
Moolgama „ „	Wattappolla

Yati-Nuwara

Kiribathcumbure

Pilamatalawwe

Bulumulle

Siyabalagode

Yatigammana

Green Manures:—The usefulness of cultivating more green manures has been carefully explained to every small-holder and the use of these is rapidly spreading into every holding in every village.

Weather:—The weather during this period was most unfavourable for any agricultural work and the progress on many small-holdings was affected.

The monsoon started well in June and continued throughout July, when many small-holders took the opportunity of supplying their vacancies, only to be faced with a severe drought in August and great disappointment. Tea crops were also affected, but restriction has helped the small-holder to carry his crop in his pocket, thus saving him from great hardships.

The District Agricultural Committee:—This Committee was formed during the early part of the year and it continues to function. Representatives from the different Village Committees and Co-operative Societies form the above Committee and a considerable amount of work is being done for the improvement of agricultural activities in the villages. A competition was organized by this Committee to further the efforts of the small-holder in the working of his holding.

Tea Restriction:—Tea restriction has certainly brought prosperity to the small-holder.

Coupons will continue to be sold until such time as the bought leaf factory owner can make it pay the small-holder to supply his leaf and coupons. The demand for uncoupons leaf is no more, as factory owners do not find it profitable to produce tea from this leaf which finds no market.

Now that there is less demand for this uncoupons leaf the small-holder is forced to rest his tea which is going to do more good than harm, as the tea on many holdings needs this well-earned rest. Some have pruned their tea and then rested it while others have left this to grow up without pruning.

As uncouponed leaf is not in demand, there is a general tendency on the part of the small-holder to neglect his holding, and not give the attention needed. Weeding has become very irregular.

The small-holder under the restriction scheme may be classed into the following groups :—

- (a) Those who pluck their leaf, or rest the tea, selling coupons, but continue to work and maintain the holding in a good condition.
- (b). Those who while anxious to maintain the holding in a good condition, are prevented from doing so owing to debt.
- (c). Those who do not find any use for work when there is an income without work.

Many small-holders are anxious to settle their debts even at the risk of ruining the holding. The areas in some cases are small, with many vacancies and interplantations which give no encouragement to the small-holder to have a good tea garden. There are many holdings in common ownership. There are sometimes over assessments on very neglected holdings which cannot be improved unless considerable capital is spent.

We have about 40 per cent. of class A, 20 per cent. of class B and 40 per cent. of class C.

Tea Coupons:—During the year coupons have been issued three times and many small-holders were disappointed at the last issue, as quantities were small compared with the two previous issues.

From inquiries made, I find that 80 per cent. of the small-holders' coupons are sold as soon as they are received. There are a few factory owners, but more traders in coupons, buying them at the different post offices from the small-holders at prices which vary according to the quantities sold. These traders in coupons buy coupons merely as a speculation and not to cover any stocks they carry or fulfil any contracts. All these coupons are in turn sold by these traders to the Colombo firms.

Bought Leaf Factories:—Tea restriction has by no means brought prosperity to the bought leaf factory owner, who was once looked up to by the small-holder as his only resource. The area which I work in has nineteen bought leaf tea factories and nine of them depend mainly on the crop that the small-holder produces; the others also take in fairly large quantities to be manufactured with their estate leaf, thus reducing costs. The factories that depended mainly on bought leaf have had to close down, the others continue to work every other day, manufacturing their estate leaf and small quantities of bought leaf.

Tea factories that formerly manufactured 10-15,000 lbs. of green leaf daily can only now get 500-1000 lbs. as a daily out-turn. For one reason weather conditions have not been too favourable for crop. But the small-holder finds it more profitable to sell his coupons rather than supply his leaf with coupons. If factory owners manufactured without coupons they will only thereby increase their losses.

Labour:—Every bought leaf factory needs a large labour force, for the small-holder's leaf involves a great deal of work before it can finally be sold in the Colombo markets.

Till very recently the daily average out-turn of labour in each factory totalled 70-80 coolies, the majority or all being Sinhalese men and women. Today one finds only 10-15 coolies employed where there is work.

Work is scarce and many who have no other source of income find it difficult to meet their expenses.

General:—The period under review has been one of great hardship to the agriculturist. The prolonged drought and the malaria epidemic have both been responsible for the small progress made in the working of small-holders. Had not tea coupons brought in this "unearned income" and increased borrowing capabilities, the small-holders' sufferings would have been untold.

In conclusion, I must thank those who have rendered me assistance and for their willing co-operation in my work.

R. L. ILLANKOON,
Small-Holdings' Officer.

Meteorological Observations 1934.

St. Coombs.

	Temperature				Mean Relative Hum- idity	Rainfall Inches	No. of Rainy days	Hours of Sunshine	
	Mean. Max,	Mean. Min.	Adopted Mean.	Mean on Grass				hrs.	mts.
January	71·4	56·8	64·1	53·9	79	9·30	19	116·32	
February	74·1	54·1	64·1	47·3	68	5·68	13	220·25	
March	74·2	55·0	64·6	49·9	75	5·08	17	205·70	
April	76·6	56·8	66·7	52·3	78	5·40	15	211·55	
May	76·4	59·0	67·7	55·7	78	3·27	10	218·20	
June	70·9	59·9	65·4	58·7	85	13·17	26	87·20	
July	70·2	58·8	64·5	56·6	85	11·04	24	122·59	
August	71·7	57·9	64·8	54·5	83	3·44	23	148·02	
September	73·2	57·1	65·2	54·4	81	1·70	16	163·90	
October	73·2	57·2	65·2	55·2	83	12·55	23	129·16	
November	73·7	55·9	64·8	52·6	78	2·44	14	194·55	
December	73·8	55·8	64·8	50·1	75	1·89	10	209·10	
Annual	73·3	57·0	65·2	53·4	79·0	74·96	210	2026·34	
	Means					Total			

THE TEA RESEARCH INSTITUTE OF CEYLON.

CAPITAL ACCOUNT TO 31ST DECEMBER, 1934.

EXPENDITURE

RECEIPTS

	To 31-12-33 Rs. Cts.	Additions 1934 Rs. Cts.	Total Rs. Cts.	By GOVERNMENT OF CEYLON :— Loan on Mortgage @ 6% per annum	Rs. Cts.	Rs. Cts.
TO LAND INCLUDING DEVELOPMENT	754,469-98	10,625-68	765,095-66		1,000,000-00	
“ BUILDINGS & LINES	818,021-54	27,563-06	845,584-60	Less Repayments to 31-12-33 102,746-41		
“ FURNITURE & EQUIPMENT	59,565-61	1,091-88	60,657-49	Repayments to 31-12-34 22,391-74	127,138-15	872,861-85
“ MACHINERY & TOOLS	100,559-29	33-50	100,592-79			
“ EXPERIMENTAL MACHINERY	13,333-33	—	13,333-33	REVENUE APPLIED TO CAPITAL PURPOSES UP TO 31-12-34 :— To 31st December, 1933	817,219-58	
“ MOTOR CAR	5,300-30	—	5,300-30	During 1934 ...	56,852-74	
				Transfers between Capital and Revenue ...	920-02	874,592-34
				“ FUNDS OVERSPENT AT 31-12-34 :— To 31st December, 1933 ...	36,776-88	
				For year to 31st December, 1934	6,853-12	
					43,630-00	
				Less Transfers between Capital and Revenue ...	920-02	42,709-98

THE TEA RESEARCH INSTITUTE OF CEYLON.

BALANCE SHEET AS AT 31ST DECEMBER, 1934.

LIABILITIES

CREDITORS :—

Accrued Interest on Government Loan	Rs. Cts.
Sundries (Detailed)	13,092-93
Subscription for Publications received in advance	11,409-20
	709-49
FURLOUGH RESERVE :—	
At 31st December, 1933	17,100-10
Add Reserved during 1934	5,450-35

Deduct : Payments during 1934

DEPRECIATION RESERVE :—

As at 31st December, 1933	163,883-62
Credited at 31st December, 1934	27,937-21

ASSETS

DEBTORS :—	Rs. Cts.	Rs. Cts.
Controller of Finance	...	17,372-99
Sundries :—		
Jeremiah Lyon & Co, £32,8.9	432-50	
Research Staff	383-99	
Advertising, Sundry Debtors	248-75	
The Estate and Agency Co., Ltd.	25-00	
Account Current, St. Coombs Estate	477-09	1,517-33
ACCRUED INTEREST	...	797-89
STOCK-IN-TRADE	...	9,649-75
CASH AT BANK :—		
On Fixed Deposits	118,793-14	
On Current Account	32,432-97	151,226-11
FUNDS OVERSPENT AT 31ST DECEMBER, 1934 :—		
To 31st December, 1933	36,776-88	
Capital Expenditure for 1934	39,314-12	
Repayment of Loan for 1934	24,391-74	
	100,482-74	
Less Revenue Surplus for 1934	56,852-74	
	43,630-00	
Less Transfers between Capital and Revenue	920-02	42,709-98
		Rs. 223,274-05

We have audited the books of the Institute kept by the Planters' Association at Kandy in which are incorporated the Estate Returns. We have not audited the Estate Accounts.

Valued inventories of Machinery and Tools and of Experimental Machinery have not been produced to us. The allocations of Capital Expenditure and of Research Revenue Expenditure as made by the Director and sanctioned by the Chairman have been accepted by us.

We are informed that the greater part of Laboratory Equipment purchased since the inception of the Institute has been charged to Revenue Expenditure.

We are not in a position to say whether the Reserves made for Depreciation are adequate.

Subject to the foregoing reservations, we certify that, to the best of our belief, the above Balance Sheet presents a true and correct view of the state of the Institute's affairs according to the information and explanations afforded to us and as shown by the books of the Institute kept at Kandy.

Colombo 28th February 1935

(Sgd.) FORD, RHODES, THORNTON & Co., Auditors.

THE TEA RESEARCH INSTITUTE OF CEYLON.

ESTATE WORKING ACCOUNT FOR THE YEAR ENDING 31ST DECEMBER, 1934.

EXPENDITURE.		INCOME.	
	Rs. Cts.		Rs. Cts.
To ESTATE REVENUE EXPENDITURE	72,870-96	By TEA SALES	134,285 lbs. ...
" CHARGES—EXPORT DUTY, ETC.	5,986-47	" DO INFERIOR "	5,147 "
" BALANCE CARRIED FORWARD ...	...		
			<u>Rs. 96,970-25</u>

INCOME AND EXPENDITURE STATEMENT AS AT 31ST DECEMBER, 1934.

To ADMINISTRATION OF THE BOARD :—		By BALANCE FROM ESTATE WORKING ACCOUNT	
Planter's Association of Ceylon	4,800-00	" Tea Cess	...
Travelling Expenses of Board	2,991-05	" INTEREST	...
Postages	236-73	" RENT OF CADDY	...
Stationery	577-55	" FEES FOR ADVISORY WORK	...
Telephone Trunk Calls, etc.	148-55		
Printing	170-00		
Legal Charges	146-74		
Auditors' Fees and Expenses	642-39		
Contingencies, Commission etc.	85-68		
			9,798-69

PERSONAL EMOLUMENTS OF

SCIENTIFIC STAFF :—

Director	24,636-60
Mycologist	17,282-90
Agricultural Chemist	17,026-61
Tea Technologist	6,883-28
Entomologist	14,662-25
Plant Physiologist	13,925-00
Superintendent	1,805-00

EMOLUMENTS OF JUNIOR & SUBORDINATE

SCIENTIFIC STAFF :—

Junior Scientific Staff	24,100-67
Laboratory Assistants & Fieldman	3,396-00
	27,496-67

Carried forward :—

Rs. 133,517-00

Carried forward :—

Rs. 323,934-51

THE TEA RESEARCH INSTITUTE OF CEYLON.

INCOME AND EXPENDITURE STATEMENT AS AT 31ST DECEMBER, 1934.—(Contd.)

Brought forward :— Rs. 323,934.54

162,549.70

" MAINTENANCE OF BUILDINGS :—		
Laboratory	920.94	
Six Senior Staff Bungalows	1,563.02	
Six Junior Staff Bungalows	702.27	
Two Clerks' Bungalows	251.05	
Miscellaneous Buildings	151.10	3,588.38
" MISCELLANEOUS ITEMS SHARED WITH ESTATE :—		
Electric Power	4,402.63	
Engine Room Staff	692.07	
Telephone—Rent and Maintenance	378.23	
Roads	1,812.00	
Sanitation	672.80	
Share of Superintendent's Furlough and Passage Fund	814.65	
Tappal Lorry and Book Fees	227.50	8,999.88
" UPKEEP OF GROUNDS :—		
Garden Cooly	147.63	
Casual Labour & General Expenses	1,107.09	1,254.72
" CONTINGENCIES :—		
Incidentals	143.85	
Provident Fund, Senior Scientific Staff	4,302.85	
Do Junior	1,302.39	
Do Sub-Staff	402.02	
Fraser Memorial Nursing Association	60.00	
Ceylon Nursing Association	65.00	
Medical Fees (Sub-Staff)	158.00	
Insurances	1,711.66	
Caretakers and Watchman	478.55	
Xmas Gratuity (Sub-Staff)	325.21	
Medical Expenses (F. R. Tubbs and F. H. Kehl)	338.00	9,282.53

Carried forward :— Rs. 185,675.21

Carried forward :—

Rs. 323,934.54

THE TEA RESEARCH INSTITUTE OF CEYLON.

INCOME AND EXPENDITURE STATEMENT AS AT 31ST DECEMBER, 1934.—(Contd.)

	Rs. Cts.		Rs. Cts.
		Brought forward :—	
To GOVERNMENT OF CEYLON LOAN INTEREST ACCOUNT	185,675-21		
" DEPRECIATION ACCOUNT	53,469-38		
" BALANCE	27,937-21		
	56,852-74		
	<u>Rs. 323,934-54</u>		<u>Rs. 323,934-54</u>

LOAN ACCOUNT.

	Rs. Cts.		Rs. Cts.
To GOVERNMENT OF CEYLON	1,000,000-00	By REPAYMENTS :—	
		1st Instalment	
		2nd	18,227-00
		3rd	19,320-72
		4th	20,479-00
		5th	21,708-60
		6th	23,011-09
		Balance due	24,391-74
			127,138-15
			872,861-85
			<u>Rs. 1,000,000-00</u>

ST. COOMBS TEA SALS 100

ST COOMBS TEAS

MARKET AVERAGE HIGH GROWN

